67

Transactions of the American Foundrymen's Association

Comprising the

Report of the Convention at New York, June 6th, 7th and 8th, 1905

With the

Reports of the Committees and Officers, and the Papers presented at this Meeting

S. N.

PREFACE.

It will be remembered that in order to economize on the printing expenses an arrangement was made last year between the American Foundrymen's Association and *The Foundry*, by which *The Foundry* set up all of the matter for the papers and had the transactions printed, with the idea of using a large portion of the matter subsequently in *The Foundry*. Last year about 80 percent of the papers were ultimately reprinted in *The Foundry*, and it is probable that this year between 70 and 80 percent of them will be used in the same manner.

This arrangement is a great saving to the A. F. A. financially and has enabled the old debts to be paid off. Papers which do not appear in time for publication previous to the meeting will be published later and paged consecutively with those printed previous to the convention so that the latter may be bound in the form of a printed volume. After the discussion has all been received and printed a subject and author's index will be gotten up and printed, which will complete the volume of Transactions for the current year.

American Foundrymen's Association at New York,

June 6th, 7th and 8th, 1905.

NOTES ON SOME RETORT COKE MELTING RATIOS.

BY C. M. SCHWERIN, MILWAUKEE, WIS.

During the writer's experience as demonstrator for one of the by-product coke companies, it has been his good fortune to have charge of cupolas of many various styles, melting iron for all classes of work, and as the question of melting ratio is of interest to foundrymen, the results of some tests are here given.

By-product coke is coming so rapidly to the fore and is replacing beehive coke to such a marked degree, that foundrymen all over the country, even when out of the district supplied by the present by-product companies, no doubt are interested.

Many statements have appeared in books and journals of the amount of iron that coke would melt, but the exact melting ratios under ordinary working conditions of the foundries have been very hard to obtain, as a melting ratio for proper foundry operation is not what the coke will do when driven to the limit, but is that ratio at which the coke will give hot, fluid iron adapted to the work being poured. Many foundrymen will tell of some excellent work which they have done at some past time, or will tell about a high ratio which upon close investigation proves to be erroneous, as in many cases the bed has been left out of the calculation, in others a certain number of pounds has been estimated to make up a bushel, and while again some simply take the cupola record as turned into the office without verifying the actual weights—an extra shovel or fork full for good luck, that many cupola tenders are prone to throw in, without recording, exerts quite an influence on the amount of coke consumed.

In this brief article the aim will be to give some exact figures of a number of heats which were run under the writer's supervision. All weights of both coke and iron were actual scale weights with no allowances of any kind.

It must be borne in mind that in every instance the cupolas used were in shops unfamiliar to the demonstrator, and were never, in any instance, in his charge more than three days. In some cases better ratios could have been obtained by carrying on the tests further, gradually reducing the quantity of coke until the limit of safety was reached.

It is my firm belief that coke is one of the most expensive things to economize on that there is about a foundry. It is very poor policy to make an apparently fine ratio without taking into consideration the percentage of bad castings due to poor iron. It is always good practice to use an excess of coke, as saving at "the spiggot and losing at the bung hole" does not increase profits. It pays to have hot iron for many reasons; firstly, it cuts off the molders favorite excuse for bad castings; secondly, it enables small gates to be used on light work, giving clean castings and an easily detached gate and a smaller proportion of remelt; thirdly, iron is more easily skimmed when pouring and slag kept back; fourthly, if a slight accident happens, such as the power shutting down, etc., there is a margin of safety to work with.

Another thing to be borne in mind when comparing ratios, in addition to the thinness of castings to be poured, is the chemical composition of the metal. High phosphorus, high carbon or high silicon iron will stay fluid much longer than low phosphorus, low carbon and low silicon iron. High sulphur in coke will make an iron set quickly even though it comes hot from the cupola. Doubtless many of the readers of this article will recall some experience of two years ago during the coke famine that will bring this fact home to them.

The so-called "semi-steel" mixtures which are simply low silicon, low carbon cast irons high in manganese, set very quickly, as every man who has ever had to keep ladles in repair in a foundry pouring this metal will testify to. The proportion of scrap to pig iron and the size of both affect both melting ratio and speed of melting, and both are constantly varying. This is another reason for keeping on the safe side in regard to the quantity of coke used.

Most of the heats here recorded are really too small to show the best total ratio as the bed enters in as too prominent a factor, but the figures are representative of the majority of the shops of this country as the big melter is the exception and not the rule.

Our experience has shown that a high coke bed gives better net result than starting with the so oft recommended 18 in. above the top

of the tuyeres. This seems to be a disputed question, however, and the writer would appreciate information in regard to the actual experience of others. By running the bed high less coke by far may be used on the subsequent charges; once the bed burns out and melting commences too near the tuyeres, trouble begins. Many, no doubt, have noticed the rush of slag at the end of a heat, even when no flux has been used; when this happens it is invariably found that melting took place very near the tuyeres, causing the blast to excessively oxidize the iron. Not only is this a disadvantage in regard to the amount of coke used, and trouble with slag, but the iron resulting will be harder than if the melting was done at the proper place, due to the oxidization of silicon, carbon, etc. Those who had the good fortune to witness the tests on coke conducted at the Model Foundry in St. Louis, no doubt saw this point nicely illustrated. The bed in those tests was brought only eight inches above the top of the upper tuyeres; on heats of about 3,000 lb. the oxidization was very heavy and slag just poured in a liquid stream out of the slag hole, and the iron lost in melting was found to be very high indeed. For these tests this method of running was of course all right as comparative data of various cokes under the same conditions was what was sought, and the tests were very painstakingly and carefully conducted under supervision of Dr. Moldenke.

In running a cupola to get the most economical results it is found that the bed should be lighted up as late as possible, and that the blast should be put on as soon as feasible after the cupola is charged full of iron. In burning the bed it is a good plan to put only a portion of the coke on the wood before lighting, and as the flame shows through, the remainder of the coke should be charged. As soon as all the wood is burned out, and the blue flame appears through the top of the bed coke, all tuyeres should be closed and charging of iron begun. Just before putting on the blast, it is advisable to open one tuyere in order to prevent any possibility of a gas explosion, this tuyere to be closed, of course, after the blast has been on a minute or so.

Another point to be considered is the running of a cupola with only one row of tuyeres instead of with two. The cupola with only the lower row will run more economically, as far as coke consumption goes, and less difficulty would be experienced in the burning out of the brick. Of course a cupola with two rows of tuyeres melts somewhat faster with both rows open than if only the lower row be used, but if the lower row be enlarged, the same speed of melting can be obtained as though two rows were used. In an endless number of cases we have found that general economy results through using but one row of tuyeres, and very nearly all the foundries which the writer has visited are now running that way. The coke used in the following tests was from the Solvay by-product ovens at Milwaukee, Wis.

TEST NO. 1.

Inside cupola diameter at doors, 42 in., at tuyeres, 40 in., at melting zone, 41 in.

Tuyere arrangement—

6 tuyeres 10 x 4 in. flaring from 6 x 4 in.

Lower side of tuyeres 14 in. above the sand bottom.

	Pounds Coke	Pounds Iron
Bed charge	1,000	3,000
Charges 2 to 11, inclusive	120	1,500
" 12 " 15, "	100	1,500
Charge 16	80	1,000
Total	2,680	25,000

Ratio of coke to iron, exclusive of bed, 1 to 13.1.

Ratio of coke to iron, inclusive of bed, 1 to 9.3.

Total time blast on, 2 hours and 5 minutes.

Pounds or iron melted per hour, 12,000.

Blast pressure used varied from 9 to 10½ oz.

Mixture used consisted of 45 percent unbroken pig and 55 percent medium weight scrap.

Castings for agricultural machinery and threshing engines were poured.

The iron was considerably hotter than needed.

TEST NO. 2.

The same cupola was used as in test No. 1.

	Pounds Coke	Pounds Iron
Bed Charge	1,000	3,000
Charges 2 to 3, inclusive	150	2,000
" 4 " 11, "	125	2,000
Charge 12	100	1,500
Total	2,400	24,500

Ratio of coke to iron, exclusive of bed, 1 to 15.3.

Ratio of coke to iron, inclusive of bed, 1 to 10.2.

Total time blast on, 2 hours.

Pounds of iron melted per hour, 12,250.

Blast pressure used, varied from 9 to 10½ oz.

Mixture used consisted of 45 percent unbroken pig and 55 percent medium weight scrap.

Castings for agricultural machinery and threshing engines were poured.

The iron was hot enough throughout the entire heat, and for pouring some of the work it was cooled by the molders.

TEST NO. 3.

Inside cupola diameter at doors, 37 in.; at tuyeres, 33 in.; at melting zone, 36 in.

Tuyere arrangement—

4 lower tuyeres, 12 x 3 in., flaring from 6 x 3 in.

4 upper tuyeres, 6 x 1¾ in.

Lower side of lower tuyeres 11 in. above the sand bottom.

Top of the upper tuyeres, 23 in. above the sand bottom.

	Pounds Coke	Pounds Iron
Bed charge	600	1,100
Charges 2 to 8 inclusive	90	1,100
Charge 9	50	700
Total	1,280	9,500

Ratio of coke to iron, exclusive of bed, 1 to 12.3.

Ratio of coke to iron, inclusive of bed, 1 to 7.4.

Total time blast on, 1 hour and 10 minutes.

Pounds of iron melted per hour, 8,140.

Blast pressure was started with 10 oz. but was reduced, as the molders could not carry away the iron fast enough.

Mixture used consisted of 45 percent unbroken pig and 55 percent medium weight scrap.

Light sewing machine castings were poured.

The iron was very hot.

The coke dropped in the bottom from this heat was picked out and found to weigh 240 lb. If this amount be subtracted from the coke used in the heat, the net ratio of coke to iron, inclusive of bed, would be 1 to 9.1.

TEST NO. 4.

Inside cupola diameter at doors, 44 in.; at tuyeres, 41 in.; at melting zone, 42 in.

Tuyere arrangement—

5 tuyeres, 8½ x 5 in.

	Pounds Coke	Pounds Iron
Bed charge	1,005	4,000
Charges 2 to 5, inclusive	240	2,800
Charge 6	240	2,300
" 7	85	1,000
Total	2,390	18,500

Ratio of coke to iron, exclusive of bed, 1 to 11.3.

Ratio of coke to iron, inclusive of bed, 1 to 8.1.

Total time blast on, 1 hour and 50 minutes.

Pounds of iron melted per hour, 10,090.

Blast pressure used, 7 to 8 oz.

Mixture consisted of 70 percent unbroken pig, with 30 percent of quite heavy scrap.

Machinery castings were poured.

The iron was hotter than needed and was cooled down throughout the heat by throwing scrap into the ladles.

TEST NO. 5.

Inside cupola diameter at doors, 34 in.; at tuyeres, 32 in.; at melting zone, 32 in.

Tuyere arrangement—

6 Tuyeres 7½ x 2½.

Lower side of tuyeres 10 in. above sand bottom.

	Pounds Coke	Pounds Iron
Bed charge	610	1,800
Charge 2	160	1,800
" 3 to 6	160	1,800
Charge 7	105	1,600
" 8	35	500
Total	1,550	12,900

160 lb. of old coke dropped in the bottom from the heat the night before was used during above heat, the amount being distributed throughout the charges. This gave 1,390 lb. of new coke used during the heat.

Ratio of new coke to iron, exclusive of bed, 1 to 14.2.

Ratio of new coke to iron, inclusive of bed, 1 to 9.3.

Ratio of total coke to iron, inclusive of bed, 1 to 8.3.

Total time blast on, 1 hour and 8 minutes.

Pounds of iron melted per hour, 8,795.

40 percent scrap and 60 percent of broken pig was used.

Very little agricultural castings were poured.

The iron was very hot.

TEST NO. 6.

Inside cupola diameter at doors, 30 in.; at tuyeres, 33 in.; at melting zone, 31 in.

Tuyere arrangement—

4 Tuyeres 10 x 2½ in. flaring from 6 x 4½ in.

Lower side of tuyeres 15 in. above sand bottom.

	Pounds Coke	Pounds Iron
Bed charge	550	1,100
Charges 2 to 7, inclusive	90	1,100
" 8 " 9* "	80	1,100
Total	1,250	9,900

*Coke on last charge could have been reduced but it was first thought that more than 1,100 lb. of iron was to be put on the last charge; on the heat which was run the previous day only 105 lb. of coke were used on the last charge to melt 1,600 lb. of iron.

Ratio of coke to iron, exclusive of bed, 1 to 14.1.

Ratio of coke to iron, inclusive of bed, 1 to 7.9.

Total time blast on, 1 hour and 30 minutes.

Pounds of iron melted per hour, 6,600.

Blast pressure not determined.

Mixture consisted of 75 percent broken pig and 25 percent scrap.

Castings for furnaces, requiring hot iron, were poured.

Iron was hot.

TEST NO. 7.

Inside cupola diameter at doors, 36 in.; at tuyeres, 38 in.; at melting zone, 39 in.

Tuyere arrangement—

6 Tuyeres 16 x 3½ in. flaring from 8 x 4½ in. The lower side of tuyeres 14 in. above sand bottom.

	Pounds Coke	Pounds Iron
Bed charge	850	3,000
Charge 2	165	2,000
" 3	150	2,000
" 4 to 5, inclusive	125	2,000
" 6	75	1,500
Total	1,490	12,500

Ratio of coke to iron, exclusive of bed, 1 to 14.8.

Ratio of coke to iron, inclusive of bed, 1 to 8.4.

Total time blast on, 1 hour.

Pounds of iron melted per hour, 12,500.

Blast pressure, 10½ oz.

Mixture used, 50 percent pig, 50 percent light scrap.

Castings for railroad and jobbing work poured.

Iron was hot.

No records in any way are claimed for these heats, the figures simply being presented as of interest to foundrymen in general as showing what is actually being done under regular working conditions. These tests themselves show such a wide variation that that fact in itself is of interest in making comparisons, particularly as the quality of the coke used was very uniform. In many cases that have come under the writer's notice, similar cupolas in both size and type would give widely different results even when the same coke was used. These variations were due to a variety of more or less understood causes, which it is not the purpose of this present paper to discuss, but when comparing the records here given with his own practice, each foundryman must bear in mind that conditions vary.

MELTING STEEL WITH CAST IRON.

BY R. P. CUNNINGHAM, HOLYOKE, MASS.

The demand for castings to stand great strength has increased to such an extent that foundrymen are often at a loss how to produce castings up to the required specifications. The manufacturers who are the most often called upon to produce castings of high strength are pump and engine builders, tool makers and car wheel manufacturers.

Take pump builders a few years ago; is was something very unusual to receive an order for a pump to stand a pressure of more than 1,000 lb. Today it is nothing uncommon to get an order for a pump to work under a pressure of 5,000 lb. and even higher. Engine builders are called upon to build engines to work under 200 lb. steam pressure, while it is only a very few years that 100 lb. pressure was considered about the limit.

I might say the same thing about tool making. The speed that the modern tools are run at today is nearly double that of a few years ago. Look at car wheels and compare the tests they are subjected to today with that required 25 years ago. The increase is over 100 percent. Yet car wheel makers have managed to make wheels that come up to the requirements. I might go on and enumerate many other branches of the trade that are doing what was once considered an impossibility. This goes to show that the foundrymen of today are alive to the requirements, and yet we often hear men say that the foundry has not progressed as fast as other branches of manufacturing.

On the contrary, considering the attention that has been paid to the foundry, we have managed to make castings that have been far above the specifications called for. Foundrymen do not always have the iron in their yard to make castings of any required strength, but by a judicious use of steel scrap we can produce castings of the strength desired.

Any one familiar with pump work will readily understand the necessity of having a perfect casting, not alone smooth and true to

pattern, but clean, close grained, yet soft enough to machine easily. Many castings go through the machine shop and erecting room, but fail when put under test. This adds cost to the manufacturing cost, as often the machining is many times the cost of molding. By adding a percentage of steel scrap we have in a great measure overcome this difficulty if the trouble is caused by porosity of the metal.

When melting steel with cast iron there are many things that require close attention in order to obtain the very best results. In charging the cupola one cannot be too careful and should be absolutely certain that all the material called for in the charge is put in. The weight of each material specified should be correct, the fuel and fluxes should be analyzed so that the exact composition of all the materials going into the iron to be made may be known.

In making high grade metal we have to contend with the impurities of the fuel and fluxes charged into the cupola besides that we have estimated on in the metal. All impurities in excess tend to weaken the metal in tensile and transverse strength, for this reason there is more difficulty in making a successful cast when using a large percentage of steel scrap. A high percentage of steel necessarily increases shrinkage, demands closer attention, requires more rapid handling in the foundry, and when very high tends to make all the operations connected with it draw away from those of a cupola metal and approach that of a steel casting. When this extreme point is reached melting in the cupola becomes very unsatisfactory.

The average thickness of a casting bears a relation to the percentage of steel desirable. For thin castings only a small percentage can be used, while for thick heavy castings a large percent is permissible. This is so because a thin casting has no self-annealing power on account of its rapid cooling, and the chilling effects of the mold. The thicker casting, on account of its slower cooling, anneals itself somewhat, and opens the grains of the metal perceptibly. The same metal in a thin casting, which is hard, would be quite soft in a heavy casting. My opinion is that it is more desirable to have a mixture with the smallest percentage of steel that will give sufficient strength and solidity to the casting for all practical purposes.

We sometimes doubt the wisdom of the engineer when he calls for castings that will stand so many thousand pounds to the square inch, because the metal that will stand the highest test in the bar is not always the most desirable. It may be brittle or flaky, with no elasticity, and yet test high. What we aim for in practical foundry work is a high grade metal that will stand a fairly high test and machine easily. It is this kind of a casting that can be made with a percentage of steel scrap melted with your iron, provided the rules are accurately followed.

My method of charging a cupola is as follows: Let us say that we want to make a casting which will require 4,000 lb. of metal, with 25 percent steel. With a cupola that lines up 48 in., we put on the bed 1,200 lb. of coke, on top of this put 1,000 lb. of iron, then 500 lb. of steel, then 500 lb. of iron, then 150 lb. coke, 500 lb. steel, 1,500 lb. iron. The coke next above the metal charge should be greater than between the ordinary charges, and the pig iron in the next charge above the steel should be of the same chemical analysis as the iron used in the steel, so that if any metal should melt and run into the steel it will do no harm. With the last amount of steel we add 1¼ lb. of ferro-manganese to every 100 lb. of steel used. We also put the same amount of ferro-silicon into the ladle. This should be done after the first metal has been drawn into the ladle. This metal should be poured as soon as it becomes quiet in the ladle.

If the casting is uneven in thickness attention must be given the shrinkage. Setting a riser on the heavy parts and after the mold is full pouring slowly until the riser is full obviates trouble. If the casting is very heavy it will be necessary to feed it, but an ordinary casting will not require this.

We have found by using two brands of iron, one high in manganese and the other high in silicon, both low in sulphur, that we can get a much finer grained casting, with more elasticity, than we could if we depended on ferro-manganese and ferro-silicon to bring these two elements up to the desired percentage. I reason it in this way: If the manganese and silicon are in the pig they are more evenly distributed than when they are put into the cupola and depended upon to become thoroughly mixed in it or in the ladle. We have never yet depended upon the pig for the entire amount of manganese or silicon wanted, but have added each in the proportion given above.

We sometimes have trouble caused by wrought scrap or hard steel becoming mixed

with the steel scrap. In either case satisfactory results cannot be obtained. With hard steel there are hard spots in the casting, while wrought iron increases porousness which is very bad if the casting is uneven in thickness.

My opinion is that mixtures of this kind will in the future be used to a greater extent than they have been in the past because the demand for this class of castings has increased and foundrymen will readily see that by this means they can build up their present mixtures to show greater strength and other desired qualities.

The result of eighteen casts with different percentages of steel showed that the highest amount of steel that could be used to an advantage is 33 percent. Above this showed excessive shrinkage and only a slight gain in strength. The highest point reached for tensile strength was 33,205, the lowest 31,890 for perfect bars. The highest transverse strength shown was 3,335, the lowest for a perfect bar was 3,180. Six bars were cast from each heat, two at the first part, two in the middle of the heat, and two at the end. In every case the two bars cast in the middle of the heat showed up best in tensile and transverse strength. The first bars were not uniform and showed small pin holes. The last bars showed up badly in every instance. Less trouble will be had with less than 33 percent than above that amount of steel scrap in the gray iron mixture.

For ordinary work 25 percent steel will give sufficient strength for all practical purposes, will machine easily and yet be close grained. This is the percent I would recommend foundry men to use unless it is for some special work. In conclusion I will say that I will be only too glad to answer any and all questions in regard to use of steel in cast iron, for I feel sure that when once tried, that great benefit can be derived.

NOTES ON PIPE FOUNDRIES AND SUGGESTIONS ON METAL MIXERS FOR FOUNDRY PURPOSES.

BY J. B. NAU, NEW YORK CITY.

Some time ago the writer had an opportunity to take a trip through some of the most modern European foundries and noticed that in many respects these foreign foundries are ahead of American practice. This was more especially to be seen in pipe foundries.

The pipe specifications of Europe, while very strict and exacting in many ways, in fact, more so than in the United States, leave the manufacturer some latitude not enjoyed here. This is especially true in regard to the iron used. Whenever and wherever possible, for obvious reasons, the European manufacturer makes use of direct metal from the blast furnace. Of course, every precaution is taken to always obtain an even quality of iron by mixing the metals running from the different furnaces in special ladles; or in mixers of special design that can be run from one furnace to the other. The principal aim of the manufacturer is naturally to give full satisfaction to the buyer, who, as is proper, insists that the pipe bought should fill all the conditions of the specifications in regard to physical tests and strength of the metal. The buyer on his side insists simply on the pipe coming up to the specifications and leaves the manufacturer unhampered as to the source from which he should take his iron.

From long experience the manufacturer is well aware that he can satisfy all physical tests with iron whose analysis may vary within certain limits and that he can obtain the right quality, either by mixing the iron from different blast furnaces, or if necessary, by correcting this direct metal by admixing a certain amount of metal melted in the cupola.

This item of quality is generally very carefully attended to and the pipes made especially in some of the most important French and German plants where the best working methods in other respects are employed, is invariably of good quality.

It can be readily understood that the use of liquid metal directly from the blast furnace is fraught with many difficulties and its indiscriminate use is liable to produce pipes of uneven and uncertain quality.

That this is so, is well illustrated by the fact that the American pipe specifications, in order to eliminate the factor of uncertainty and of uneven quality, prohibits the use of direct metal in the manufacture of pipes, and specifically states, that the iron should be remelted in a cupola or an air furnace. Of course this remelting leaves no excuse to the manufacturer in regard to the quality of his iron, but still it has disadvantages that can not be overlooked, one of which is the greatly increased cost of the iron when thus remelted. Another disadvantage lies in the danger of deteriorating the quality of the iron to some extent by increasing its sulphur content from the contact with fuel

or flame. The best and cheapest way would naturally be to follow the practice already described, by mixing the different brands of irons running from the various blast furnaces and, if necessary, to correct the quality of the so mixed irons with irons remelted in the cupola. Such a proceeding prohibited by American specifications is only possible where the foundry is built near the blast furnace. Foundries not so located, are naturally excluded.

Still in order to get all the benefit that the use of direct metal would undeniably afford and yet avoid all the danger of the uneven quality, that alone guided the framers of the American specifications in prohibiting the use of direct metal. The use of a heated mixer of sufficient capacity is here recommended.

Since a few years ago, such mixers are being introduced in Europe in connection with steel works and they give the very best satisfaction. The writer had occasion to see one such heater of a capacity of 250 tons in a basic Bessemer steel works. It was heated with producer gas and provided with regenerators. Such a mixture is more to be considered in the nature of a gas-heated air furnace with the exception that the iron, instead of being melted in it, it brought liquid from the blast furnace and poured into the mixer where it can be kept hot and liquid for any desired length of time.

Since the steel works find that heated mixers give such good satisfaction, why should the foundrymen not follow in the same steps, wherever it is possible to do so. The small non-heated mixer that the writer saw in some German pipe foundry, gave good satisfaction and the iron could still be used after two hours waiting.

Heated mixers would give better satisfaction, undoubtedly, under the action of the flame, which must be of a slightly oxidizing nature, some undesirable refining of the iron would take place, and a small part of the silicon and manganese would be burnt out. But as the iron is poured liquid in the mixer, the oxidation of silicon and manganese would be much less than in the air furnace or the cupola, where from ¼ to 1-3 of the silicon is burnt out, mostly during the melting period. In this respect the heated mixer, where no melting is done, should be far more advantageous.

But it has other advantages. It is a well known fact, that the mixer as such is an excellent apparatus for eliminating in a short time a large percentage of the sulphur contained in the iron. In fact this elimination reaches easily 50 and 70 percent. The quality of the iron will therefore be considerably improved in the mixer. In the cupola the contrary always happens.

Since the metal can be kept hot to any degree in the mixer, this affords us means to correct at once the quality of the metal by throwing and melting in it whatever cold pig may be necessary to obtain the right analysis.

Thus the use of the heated mixer for foundry purposes in connection with the blast furnace would seem to present very marked advantages:

1. It would allow the use of direct metal from the blast furnace, thereby saving the remelting cost which is always high.

2. It would afford an easy and cheap means to eliminate a large percentage of sulphur, thereby, contrary to cupola practice, improving the quality of the iron.

3. It could be used directly to correct the quality of the metal by melting in it a certain amount of cold pig iron, with probably less cost than when the melting is done in the cupola and with certainly less absorption of sulphur during the melting, because the solid pig will melt in the liquid bath and be removed from contact with the flame.

Naturally such a mixer could be used for other than pipe foundry purposes, when proximity to the blast furnace allows its adoption. It would even allow an independent large foundry to use liquid iron from a near-by blast furnace belonging to another company. Both companies would benefit by the practice.

Coming back now again to European pipe foundry practice, which led us to the above consideration of mixers, it is in many other respects that improved means are applied, all tending towards a general cheapening everywhere. What one notices first in the most modern European pipe foundries is the complete absence of pits. The molding and pouring is done on an upper floor to which one-half of each pipe flask is fastened; the other half is left free to be slid back. The flasks are never taken from their place; the finished pipe alone is lifted up by the crane, which having less weight to lift, can be lighter than would otherwise be the case. The lower end of the flask hangs freely down to within a certain distance of a lower floor and is accessible from every side. The drying of the flasks is obtained by means of producer gas or even blast furnace gas. The producer gas is made in gas producers situated outside the

works and let through underground gas flues underneath the rows of flasks. Here special burners, varying in the different foundries, are used to dry each flask thoroughly and rapidly. In most places gas is also used to heat the core ovens. These arrangements also vary from place to place.

In one foundry in Eastern France, where coke is very expensive (fully $5 a ton), special arrangements are made to burn coke screenings from blast furnace coke in the core ovens.

The use of this fine coke, otherwise lost, was the cause of a very great saving in the drying of the cores. After the pipe is cast the sand falls from the flask and is taken up by conveyors, and after being cleaned and screened, is taken by conveyors to the top floor where it will be used again in the ramming of the flasks. In some foundries the flasks are put up exclusively in straight parallel rows, in others, especially for pipes of less tnan 25 in. diameter, revolving pits or drums are used, somewhat similar to what is done at the Chattanooga plant.

In the case of revolver systems the drying of the flask is also obtained with gas. Some very ingenious drying appliances are used in these revolving systems. Tarring appliances also are very modern and of an improved style. In fact the work everywhere is reduced to a minimum.

THE USE OF PLASTER-OF-PARIS IN THE FOUNDRY.

BY EDWARD B. GILMOUR, PEORIA, ILL.

The title of this paper may seem a little strange but as plaster of Paris is used to a great extent in most of the arts, it will not be so surprising to find it occupying a little corner in the foundry.

Plaster of Paris is gypsum burnt in a kiln at a temperature of 250 degrees and subsequently powdered and ground to a fine uniform flour. When so prepared it possesses the valuable property when mixed with water of setting into a solid mass. It receives its name from the fact that it is mined in great quantities in the environs of Paris and is used to a large extent in art work. It takes a place in the foundry in the form of patterns; some founders use it to a large extent in making match boards. These match boards are not very satisfactory if they are kept in constant use as they are brittle and consequently very easily broken. While upon this topic I would say that good match boards are made from a mixture of litherage 3 parts, parting sand 90 parts, and linseed oil 7 parts.

In a large agricultural establishment with which I was formerly connected we used as much as 20 barrels of plaster of Paris per month, so it can be readily seen to what extent the material was used in this one place. It was the means of saving thousands of dollars in producing their work. We used it principally in the making of patterns for drop hammer dies in order to straighten the malleable castings which had become warped in the process of annealing.

Our method of procedure was to take the original metal patterns before being gated up, place them in the sand as you would if you intended to cast them; viz., up to the joint, making the joint in the regular fashion and as straight as possible. It is good practice to prove the drawing of the patterns so as to get the joint in the best place in order to get out the malleables after having been straightened. Now get a common wooden box, place over the mold, see that it has plenty of taper so as to facilitate the drawing of the plaster cast from the sand. Coat the mold with oil, mix the plaster with warm water (as you will get better results in setting), to a consistency of thick cream. Pour it into the box or flask upon one-half of the mold, and when solidified roll it over and take away the sand which made the original mold, leaving the patterns in place. Dress up the joint, again coating over the mold with oil, and repeat the operation upon the plaster mold, which will give you a perfect impression of the casting which you have to straighten. It is essential to cast a nut or something similar into the plaster in order to draw the plaster pattern out of the sand after it has become hard enough. It is necessary to trim up the mold, separate it and withdraw the patterns, repair all of the defects, and give the casts a coating of shellac varnish. They are then ready for use.

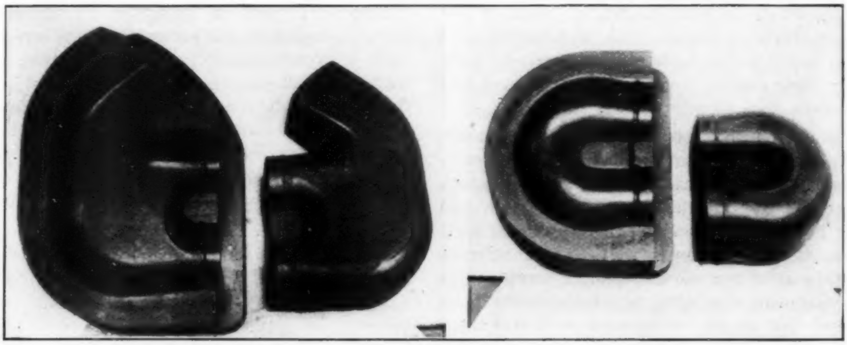
Some one may wonder why we use the original patterns in order to make the plaster patterns. The reason is simply this, that when you cast the dies from the original patterns you have the shrinkage of the casting in the die, you have also the shrinkage upon the malleable casting. It will be said that malleable castings shrink more than grey iron, which they certainly do. In making the patterns for malleable castings we allowed the same shrinkage as in grey iron, viz., one-eighth inch to the foot, but

with the process of annealing the castings expand enough to bring "malleable" to a uniform size with grey iron castings, consequently the castings are of the same size as the impression in the dies.

The accompanying cuts are two sets of drop dies for the pipe connections for a grain weighing machine, the smaller ones being used for the top dies. The method for making these plaster casts is a little more intricate, the molds being made as you would make a regular loam mold, with sweeps having a frame made of the flat section, with pin holes on the centers, so that the sweeps will work on the circle as you would make a regular elbow or Y pipe.

could better judge what to do, and how to do it."

Possibly he was referring to some problem which he had personally met with in relation to Cabinet making—possibly he was addressing a convention of foundrymen. His words, however, indicate the real usefulness and value of special methods of factory or foundry accounting, designed with regard to the peculiar nature of the business to which they are to be applied. To show where we are, and whither we are tending is very generally regarded as being altogether an accounting proposition, but to know to the detail necessary in these days of close competition, the ordinary work of the accounting department must be supplemented



THE USE OF PLASTER-OF-PARIS IN THE FOUNDRY.

In order to get as true and perfect castings as possible we are very careful not to rap the patterns sideways, only a slight tap downwards being given. When the pattern is drawn no tools are used upon the face of the mold; simply take a camel's hair brush with wet blacking and carefully paint this on as regularly as possible; afterwards skin-dry the mold and you will have a perfect casting. We usually make these molds in iron flasks so that we can leave them over night in the sand as it tends to toughen the metal, which, in fact, is a high grade iron. These castings are subjected to very heavy strains on account of the continued pounding of the drop hammer.

ACCOUNTING. — AN INFLUENCE TOWARDS LESSENING COSTS AND INCREASED EFFICIENCY.

BY KENNETH FALCONER, MONTREAL, P. Q.

Lincoln once said, "If we could first know where we are, and whither we are tending, we

by the work of those more closely connected with the productive operations of the business. To record in detail the exact standing of each department, as well as the entire organization, to show the individual result of each of the thousand and one influences, which in a manufacturing business make for success or failure, betterment or inefficiency, in any department is not the work of the accountant alone, nor of the manager or engineer alone. It is a combined field of accounting and detail of management and is an executive department in itself.

One of the first steps in devising a proper system of factory accounting, of which cost finding is such an important detail, whether in relation to the manufacture of castings or the making of any other product, is to divide the organization into its component departments, and to provide that the operations and transactions of each may be intelligently recorded, and the results of such operations and transactions clearly defined.

While it is impossible to lay down any

general rule on this subject, the best primary lines of division will usually be to classify the departments as productive, selling and general. Of the productive departments, some may be what may be termed "indirectly productive," others actually productive in the sense of receiving raw or partly manufactured material, and delivering such material in a further or completed state of manufacture.

Another point in planning methods of accounting is a very clear determination of the results to be sought in the case of each department, the use to which such results will be put, and the value which it is hoped to secure by such use. If, before the general scheme is determined upon, these points are thoroughly considered, it will frequently result in the elimination of useless work and records, and the avoidance of duplication of work, by using the same original records as the basis of two distinct lines of information.

Having defined the departments into which the organization is to be divided, having clearly outlined the information it is desired to secure, and the use to which such information will be put, the problem practically resolves itself into as many sections as there are departments. While in a manufacturing plant many of the departments may often be treated on the same lines, yet, on the other hand it is frequently the case that the methods applicable to one would not secure the best results in another; that means perfectly legitimate in one case may be illogical and absurd in the very next department. For instance—as regards the distribution of indirect expenses, a very general practice is to distribute them in some established ratio which they may bear to labor, either as a percentage, or on an hourly basis. While this may be generally correct, under some circumstances there is no distinct relation between these two factors, and some other known factor of the business, possibly machine hours, possibly weight or measurement of output, should be adopted as the basis on which to apportion indirect manufacturing expenses.

In connection with factory or foundry accounting, to know whither we are tending means much more than merely knowing whether the ultimate result is progress or retrogression. Progress or decay in an industrial organization is the final result of many different influences of varying strength and weight. Some are for, and some against success—some are direct and some are indirect. To show the tendency of each one of these influences, to record whether they are increasing or decreasing in force, and the effect of any line of action intended to strengthen or weaken any of these forces; to show the final results of each, and clearly indicate the relation between cause and effect, between influence and result, more than justifies the expenses involved in installing and preparing a proper system of accounting. Like other details of management, the real test of the worth of such work lies in the dollar and cent value of its results.

Accuracy of results is a prime essential of the work of any accounting department, but promptness in securing such results is of almost equal importance in relation to factory or foundry accounting. The interest of the management, even in important information depends largely on the promptness with which such information is furnished; the value of such information to the management as an influence towards lessened costs, or increased efficiency decreases in an ever growing ratio with each day that passes between the close of the period referred to, and the date that the information is available for examination and study.

Much of the value of many otherwise efficient systems of factory accounting and cost finding is lost by failure to so tabulate the information secured, as to most graphically bring out its salient and important points. Apart from the question of the relative advantages of figures, curves and diagrams, it will often be found that records apparently unimportant in themselves, may convey very important meaning if shown, not in comparison with similar records of preceding periods, but in conjunction with data of related interest during the same period.

Accounting in the ordinary sense is the science of securing certain records and information, irrespective of their further use, and the ordinary work of the accountant is complete and finished in itself. Factory accounting has been defined to be the science of securing, verifying and recording the operations and transactions of a productive organization, in such manner as to afford a basis for judicious action and prudent decisions regarding its future conduct. Although complete and finished in itself does not in itself represent its own entire value. It should be the basis of cost reduction, the ground of improved efficiency, and unless it is, it fails of the very purpose which justifies its existence. Accounting is a passive system of records, fac-

tory accounting an active influence towards success.

Methods of accounting, whether designed for a factory or a foundry, on the lines I have tried to indicate—recording where we are to the detail, and to the manner which I have tried to point out—showing whither we are tending, not as regards to final result, but as regards each separate influence, and each separate department will supply to the management a basis for their very best judgment, and be in itself a direct influence towards the ultimate success of the entire organization. There are a thousand and one influences in every manufacturing plant, which make in some degree for success or failure, for betterment or retrogression of some one or more departments. To know absolutely the result of each of these is one of the best possible means of guarding against them, or of strengthening them according to the nature of their influence.

SOME THOUGHTS ON MODERN AMERICAN FOUNDRY PRACTICE.

BY JOHN C. BURNS, PLAINFIELD, N. J.

In preparing this paper my thoughts carry me back to the day when I got my first appointment as a foundry foreman. The gentleman who clothed me with the power, said on that occasion, that as near as he could see, the future would place more confidence in the native mechanic than the past.

Heretofore most of our foundrymen had to come across the big pond to be eligible. The reason for this was because they had to serve a seven-year apprenticeship, which was thought to be essential for the boy who was to master the details of foundry practice.

The present practice is somewhat different, and the foreman, like the journeyman, is slowly but surely becoming a specialist, although he is no less a mechanic. The foundries of the future will be operated as specialty makers to a greater extent than at the present time.

The foundryman who makes a specialty of heavy machinery will not be in it on the lines traveled in shops making light snap work, and vice versa; as each make a class of castings to which the other would be unfamiliar. The conditions of mixing are different also, although each may be expert in his own line. When these men meet, and enter into a discussion about foundry practice in general, each leaves the other with the impression that the other fellow is not in it. Improved machinery is playing a sharp game just now in the output of both classes of work.

The heavier class of work is handled with electric cranes and air hoists. Pneumatic chippers, etc., reduce the cost, and the total output per man increased. On the lighter class of work stripping plates, compressed air machines, vibrators and electrical appliances have come into almost universal use and the man who does not use them will not be in it.

Carrying iron by hand by the three-men system should be, and is being, relegated to the rear in all modern foundries. Over-head systems are to be commended for delivering the iron to the floors quickly and hot, and the time saved per molder may be figured as an investment. This can all be done by laborers.

The mixing of facing can be done by power now, as devices are on the market which have passed the experimental stage and are great money savers over and above hand power. Electricity is playing an important part in some foundries, being used not only for light but power as well; its latest use, I hear of, being for the wind and is placed very close to the cupola, doing away with the excessive friction by long travel.

The practical foundryman of today, if he wants to stay even with the other fellow, must avail himself of all labor saving devices, and be able to mix his iron by analysis.

But meet the old timer and he will tell you that he has always had good results without these things. He thinks that nowadays the molder does not know as much as formerly, the foreman does not know as much, and there was no need of a chemist in his business in the good old times.

The facts of the matter are that years ago better prices were paid and the requirements were not so severe. Competition is keener now, and the manipulation of mixtures to suit the case did not exist to any extent. Therefore it is the fellow who keeps up to date as regards fixtures and appliances and takes advantage of them to cheapen and increase his output who will be one of the successful ones and Mr. Knowall, "the old timer" will be on your pay roll.

"NEEDED IN THE BUSINESS."

BY BENJAMIN D. FULLER, ALLEGHENY, PA.

The first impression gained by a young man upon entering the foundry, provided he be one possessed of feeling or sensibility at all above the average, is generally such as to fill him

with awe, and a desire to turn tail and run. The confusion of sound, the smoke and dirt, the sparks from the cupola, or from molten metal splashing upon the floor, the whir of the electric traveler rushing down the shop conveying a ladle of glowing iron, are enough to cause a timid boy to catch his breath.

These conditions are doubtless responsible, to some extent, for the fact that few young men of ability, sufficient to mark them as above the average, are to be found among employes of the foundry. That such is the case is to be deplored, as there is certainly room as well as opportunity for boys of this character.

The son of our successful iron founder, after his schooling. Does he enter the foundry as an apprentice, go through from start to finish and learn the business which he is at some time likely to be called upon the manage? Not often, I am sure. He may take a position in the office or on the road; this being more congenial, more suited to his taste, but adding nothing to the intelligent advancement of founding. We need the bright, intelligent boy possessed of, at least, a fair education as a basis upon which to work, not necessarily the college graduate, although if the graduate has the nerve to put in three to five years rooting out such knowledge as can only be gained by becoming shop hand, he will be by far the better man, and the foundry as a whole will certainly be the gainer by reason of what he will bring to it.

Let such an one start with the core bench, will he simply follow out a daily routine of unthinkingly pounding sand such as furnished, into boxes such as furnished, his brain the meantime thinking of whistle-time, the date with his girl, or the sparring bout he is to witness after supper? No! He will investigate the nature of the sand and the core binder, the reason for doing certain things certain ways, and how to improve upon set ideas. When a core blows he will examine the casting and try to discover the why and wherefore? Was the sand too "tight?" How far did the gas have to force its way through the sand before reaching the vent or channel of escape? When a casting cracks, due to shrinking upon an unyielding core, or upon a rod extending from side to side of core, forming a perfect bar of resistance to the incoming walls of the casting, he will be quick to discover the reason for such an occurrence and intelligent enough to provide a remedy.

When, in after years as manager or proprietor, he sees the same thing occur to a casting, he will not sit down and dictate hot letters to the pig iron producer about his "bum" iron, but will know enough to go after the core maker.

In molding he will study the nature of different sands, to determine the proper sand to use to reach a desired end. In becoming familiar with this single item, or, in other words, if he be intelligent enough to learn what there is to be learned along this line, he will, in after years, not only be able to improve his product, increase his revenue, but also save the molder many an undeserved cursing.

He will learn to decide in his own mind when he sees a pattern whether it should be molded in green sand, dry sand, loam, core work, or sweep, etc., etc. Such an young man would investigate cupolas and their management, fuels, ladles, cranes, and other equipment, labor saving devices, molding machines. Here he has a wonderful field which will furnish endless *spice and variety;* for let one get well into this work and he will shortly be convinced that he did not know as much about molding as he may have imagined.

He will also learn to respect the cleaning room as an educator, as I have seen castings which looked fairly well after being brushed and cleaned by hand or in the cleaning mill, look simply "rotten" after being sand blasted, each particle of slag and dirt being rooted out. This will cause much scratching for ideas as to proper gating, etc. A sound casting from a good true pattern, molded in the proper sand to insure a smooth surface, and cleaned by barrel and sand blast, is a thing of beauty.

Boys should not be afraid to ask questions or to make suggestions. Go to the foreman, and if he be the proper sort of a man he will gladly furnish information, and listen to what you have to suggest. Allow me to say here, that I differ with the idea seemingly held by some foundrymen, that a foreman should be one ever ready to "swell up" and *spit out* "hot language" like unto an old iron tea kettle about to boil over.

Were there a greater proportion of bright, energetic recruits to the foundry trade and a less number of that class but little removed from "The man with the hoe," there would be but little use for such foremen.

THINGS NEEDED IN THE FOUNDRY.

BY DAVID SPENCE, CHICAGO, ILL.

The last twenty years have seen a great change in the foundry trade. Molding is an

art, and the foundryman in one sense is an artist. For years very little attention was paid to the foundry or its needs, but during the last few years owners of foundries have taken more interest in this line of work, and we are getting better foundries.

There are other needs besides the building. One of the greatest of these is a good class of foundry superintendents or managers, men who have a good knowledge of their line of work and can impart information to those under them and be a help to them.

Then there is the need of good molding sands suitable for all grades of work. Sands suitable for heavy work will not do for fine castings, and here is one of the great troubles in our foundries today.

As we are meeting in the great sand state, I hope to hear from others on this need in our foundries to produce first-class work.

Another great need is first-class facing. For heavy work we need a good strong sea coal and for fine work a fine bolted sea coal. After the mold is made we need a good first-class plumbago, and the best is none too good. Still another great need is the right kind of good iron, suitable for the class of work being made. This we have in abundance East, West, North and South, but we must know how to select them for our purpose.

Then we need men who know how to mix iron properly to produce good sound castings.

The last great need is foundrymen who will be proud of the foundry trade, and will take an interest in everything that will advance it. They should hold out for a price on their castings, and not be trying to undermine their brother foundrymen by continued cutting. Let the man who produces the best castings hold his trade by good first-class work. Then we will be making better molders, better men, have better foundries, better work and more of it to do.

THE EFFECT OF MANGANESE IN LOW SILICON CAST IRON.

BY H. C. LOUDENBECK, WILMERDING, PA.

The following tests were made to show the effect of manganese on the chill and fracture of cast iron having a low percentage of silicon.

CONDITIONS OF TESTS.

Mixture was melted in a small test cupola having a diameter of 16 in. inside the lining. Blast pressure 6 oz. Size of chilled test pieces 3 in. x 4 in. x 10 in. These were chilled on the edge, or the 3 in. x 10 in. face. Test pieces were also cast in the sand to determine fracture, and also to obtain drillings for test. These were the same size as the chilled test pieces.

TEST NO. 1.

Mixture { No. 1. Charcoal Pig Iron....40 lb.
No. 6. Charcoal Pig Iron....60 lb.
80% Ferro Manganese....... 2 lb.

	Estimated Analysis	Actual Analysis
Silicon	.63%	.55%
Manganese	2.01%	1.38%
Total Carbon	3.77%	3.67%
Combined Carbon		.62%
Phosphorus	24%	.22%
Sulphur	.02%	.048%

Depth of chill, 2 in.; grain of chill, coarse and fibrous; fracture of sand piece, open, graphitic and very black.

One inch test bar broke at 2,600 lb. per sq. in., twelve inches between supports.

TEST NO. 2.

Mixture { No. 1. Charcoal Pig Iron..40 lb.
No. 6. Charcoal Pig Iron..60 lb.
80% Ferro Manganese..... 3 lb.

	Estimated Analysis	Actual Analysis
Silicon	.63%	.49%
Manganese	2.81%	2.00%
Total Carbon	3.77%	3.72%
Combined Carbon		.74%
Phosphorus	.24%	.25%
Sulphur	.02%	.03%

Depth of chill, 2¼ in.; grain of chill, very coarse and fibrous.

Fracture of sand test piece, mottled on the outside, black in the center.

One inch test bar broke at 2,600 lb. per sq. in., twelve inches between supports.

TEST NO. 3.

Mixture { No. 1. Charcoal Pig Iron..40 lb.
No. 6. Charcoal Pig Iron..60 lb.
80% Ferro Manganese..... 3¾ lb.

	Estimated Analysis	Actual Analysis
Silicon	.63%	.49%
Manganese	3.63%	2.25%
Total Carbon	3.81%	3.70%
Combined Carbon	1.17%	1.03%
Phosphorus	.26%	.24%
Sulphur	.02%	.025%

Depth of chill, 2.30 in.; grain of chill, very coarse, back of chill mottled.

Fracture of sand test piece, chilled on corners and sides but gray in center.

One inch test bar broke at 1,755 lb. per sq. in., twelve inches between supports.

TEST NO. 4.

Mixture { No. 1. Charcoal Pig Iron..40 lb.
No. 6. Charcoal Pig Iron..60 lb.
80% Ferro Manganese ..... 5¼ lb.

	Estimated Analysis	Analysis
Silicon	.60%	.74%
Manganese	4.51%	3.80%
Total Carbon	3.87%	
Combined Carbon	1.00%	2.52%
Phosphorus	.27%	.27%
Sulphur	.02%	.02%

Chilled test piece, white throughout.

Fracture of sand test piece, white with a few graphitic spots in center.

One inch test bar broke at 1,465 lb. per sq. in., twelve inches between supports.

The above tests indicate: First—In cast iron having from .50 to .70 percent silicon, the addition of manganese above 1.38 percent, gradually hardens the metal, the combined carbon and the chill increasing with the addition of manganese.

NOTE.—The above statement should be modified for when smaller or larger castings are made the size of the casting has a marked effect on the cooling of the metal and in that way affects the carbon.

Second.—When the manganese is high and the casting large enough to be gray, the fracture is open and coarse, and the graphite scales very large and crystalline.

Third.—High manganese to a certain extent prevents absorption of sulphur from coke.

When the manganese is below 1.38 percent (this percentage is only approximate and depends largely upon the percentage of silicon present; the lower the silicon the sooner the manganese will commence hardening iron), its action is different; it softens iron, lowers the combined carbon and decreases the chill; this effect is more marked where the sulphur is high, which the following examples will illustrate:

TEST NO. 5.

Analysis of metal direct from cupola:

Sulphur .... .12 per cent.
Silicon .... .71 per cent.
Manganese .... .27 per cent.
Combined Carbon ....1.60 per cent.
Depth of chill ....1.75 inches

Analysis after adding one-half pound of 80 percent Ferro Manganese to about 200 lb. of metal.

Silicon .... .71 per cent.
Manganese .... .34 per cent.
Combined Carbon ....1.35 per cent.
Depth of chill ....1.50 inches.

TEST NO. 6.

Analysis of metal direct from cupola:

Sulphur ....1.25 per cent.
Silicon .... .87 per cent.
Manganese .... .27 per cent.
Combined Carbon ....1.35 per cent.
Depth of chill .... .70 inches.

Analysis after adding one pound of 80 per cent Ferro Manganese to a ladle of about 200 pounds of metal:

Silicon .... .83 per cent.
Manganese .... .63 per cent.
Combined Carbon .... .50 per cent.
Depth of chill .... .30 inches.

TEST NO. 7.

Anaylsis of metal direct from cupola:

Silicon .... .57 per cent.
Manganese .... .35 per cent.
Sulphur ....0.123 per cent.
Phosphorus .... .39 per cent.
Combined Carbon ....1.20 per cent.
Depth of chill ....1.40 inches.

Analysis of the metal after adding 3½ pounds of 80 percent Ferro Manganese to about 200 pounds of iron:

Silicon .... .59 per cent.
Manganese ....1.70 per cent.
Sulphur ....0.023 per cent.
Phosphorus .... .39 per cent.
Depth of chill................. 2½ inches.

Combined Carbon, very high.

From the above it may be seen that manganese can be used for not only decreasing but increasing the chill, depending upon the amount of manganese used and the nature of the mixture. It will also be noticed the marked decrease in sulphur where considerable manganese is added. Such a difference is not always attainable, but the conditions in the case were favorable for such a reduction. The metal was very hot and after adding the ferro manganese the mixture was thoroughly stirred and skimmed.

CONCLUSIONS.

Manganese can be used to an advantage in low silicon and chilling iron in the following cases:

In mixtures where the percentage of scrap is large and the sulphur necessarily high (this will occur in a car wheel mixture where usually a large portion of old metal is used), the result of this increase in manganese would be lower sulphur, lower combined carbon, less chill and greater strength.

Very often chilled plates are required, having hard chilled faces and soft backs suitable for planing. Manganese added in the right proportion will reduce the tendency to mottle, and make a comparatively soft graphitic back

In all cases where chilling irons are melted in a cupola and the sulphur is over .07 percent, the iron can be strengthened by the use of ferro manganese or pig iron having a high percentage of manganese.

There are some cases where the manganese should be kept low. In the manufacture of large hydraulic cylinders it is necessary to have a close mottled iron to withstand the pressure and prevent leakage. If the manganese is too high this mottled structure is replaced by a coarse graphitic structure, which is not satisfactory for this class of work. This is illustrated by the two following examples:

Analysis of hydraulic cylinder having 6-in. wall, fracture having a close mottled structure; cylinder very satisfactory.

Silicon	.90 per cent.
Manganese	.25 per cent.
Total Carbon	3.34 per cent.
Combined Carbon	1.44 per cent.
Sulphur	0.136 per cent.
Phosphorus	.39 per cent.

Analysis of a hydraulic cylinder having 6-in. wall, fracture open and not mottled; cylinder not satisfactory.

Silicon	.71 per cent.
Manganese	.49 per cent.
Total Carbon	2.98 per cent.
Combined Carbon	.65 per cent.
Sulphur	.12 per cent.
Phosphorus	.31 per cent.

A study of the above analysis will bring out the following facts:

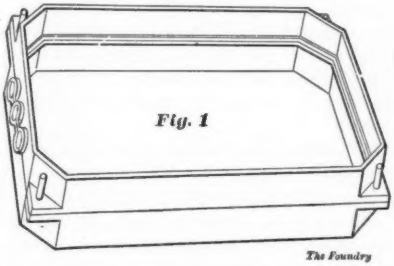
Manganese was too high in the defective cylinder, which accounts for the low combined carbon and soft character of the mixture. Without doubt this cylinder would have been satisfactory if the manganese had been lower. This was true of subsequent tests. Twenty cylinders were afterwards cast which were satisfactory, having low manganese, high combined carbon, and a fracture having a mottled structure.

PRACTICAL BRASS-FOUNDING FLASKS.

BY C. VICKERS, MILWAUKEE, WIS.

As a proper choice of flasks is a great aid to success in brass founding, a few words on the subject may interest the members of this association.

An excellent shape for a flask for all kinds of brass work is the one shown in the cut. It will be noticed that the pins are placed on the corners, the flask really being octagonal in shape. This arrangement makes a very neat flask and one that occupies the minimum of floor space. It is also very light, and the position of the pins greatly facilitate a clean lifting of the cope, a thing so desirable in brass molding. The sides of the flask are straight, the sand being retained by a narrow ledge on the inside of flask at the joint. My experience has been that a straight side flask with this ledge inside will hold the sand much better than a flask whose sides are beveled, as the cope of this latter flask has a tendency to sag and cannot be rammed as soft as the straight side flask. The object in placing the pins on the corners is to abolish the projecting lug, as projecting lugs are a bad feature on any brass molder's flask, because they bind very easily.



In lifting off a cope, the molder must balance it, and this is made more difficult the farther the pins are extended out from the sides of the flask. The handiest sizes for brass molders' flasks are 18 x 12 x 6 and 11 x 16 x 5½ inside measurement, that is, 18 in. long, 12 in. wide, and with a 3-in. cope and drag. The 11 x 16 x 5½ size is, I think, to be preferred for general use. Larger flasks than these are heavy and awkward to handle and unless they are barred are liable to drop out frequently, so it is more economical to have a smaller gate, with fewer patterns, and a light and easy working flask, than a larger gate, a few more patterns and a heavy clumsy flask.

Flasks for brass work are much better with four pins than three, the old-fashioned projecting lugged three-pinned flasks, are undesirable for any kind of brass work not only on account of their liability to shift but because they do not lift with the steadiness of four-pinned flasks. Indeed, a two-pinned flask is to be preferred to a three-pinned one, provided the pins are carried by the handles of the flask as in the snap.

Another point about pins is to make them with a slight taper, as if they are perfectly

straight and accurately fit the pin hole, they cause much trouble in securing clean lifts, because the molder cannot feel the vibration imparted to the cope by rapping on the bench, which is such an important factor in securing perfect work.

Also when the straight pin becomes rusted, as all pins are liable to, it is a difficult job to get the two halves apart and often results in broken flasks.

Pouring Off.

While it is unnecessary to equip the ordinary brass foundry with an electric crane, some sort of a system for lifting and carrying is very desirable. Though comparatively few brass foundries have any such system, they still stick to the old-fashioned man power. Generally the metal is taken from the furnaces, by the aid of an iron bar, with a man on either end, another steadying the tongs, and it takes three men to do the pouring, irrespective of the size of the pot, or the amount of metal it contains.

When the pot holds 200 lb. of metal or over, it is often a very awkward and dangerous job to take it from the fire in this manner.

All this hand work can be avoided and pouring off become a simple and easy business for one man and a boy by the installation of an overhead track, a trolley and a triplex block. You do not need a shank for pouring off as a shank needs three and often four men to use it with a tackle.

The overhead track can reach all parts of the foundry with the aid of switches and pouring can take place in half a dozen places at once if the necessary tackle is put in.

The pots are poured with the tongs, using the same tongs as with the bar, the tackle is hooked into the loop on the hinge of tongs, and a hook 18 in. in length is a handy connection between tackle and tongs.

To remove a pot from the furnace the trolley is run over it, a boy having charge of the tackle, the furnaceman or molder places the tongs on his pot, securing them with the ring as usual, then the hook on the block is lowered into the furnace and catches the loop at hinge of tongs. On the hoisting chain (a triplex block has a single chain), I had a ring large enough to slip over the handle of tongs to hold the pot from overturning. This ring must be slipped off before pouring or the crucible cannot be tipped.

The pot can be skimmed as it hangs, after leaving the furnace, so there is no lowering and hoisting, as with a shank, so the metal leaves the hearth quicker than when carried by hand. When the molder pours the boy steadies the chain, raising and lowering as required.

A SUCCESSFUL FOUNDRY COMBINATION.

BY ARCH. M. LOUDON, ELMIRA, N. Y.

I have chosen this subject for the purpose of the greatest good to be accomplished by the great combination, a foundry foreman, a foreman patternmaker and a foundry chemist, working as one, to accomplish the most successful results for every foundry owner.

I will first briefly relate the usual standpoint of 90 percent of the above parties and then give as concise an opinion as possible of how this combination should work for success.

Take the foundry foreman, as he is generally found, and he has become, in his own mind, one of those men who has attained all the glory of the sand heap, by being selected as foundry foreman. As he grows older in the business and obtains more important positions, and with age, he does not improve like whisky, for he is always in a state of mind that he did this and that, and no one can tell him his business, for he has spent twenty or thirty years at it. The idea of the foreman patternmaker even suggesting how he should mold this piece or that, puts him in such a frame of mind that he would not condescend to recognize him if they met. Next he may have the foundry chemist to contend with and when they meet over results or work to be done it is the same again, the idea of a chemist trying to tell him his business after the years of practical experience; why before such a man was invented as the foundry chemist, he was obtaining A-1 results, (many a time the results were in his mind because he did not know to the contrary), or the conditions years ago were more congenial to good results. Today, however, we are assailed with many difficulties which are sometimes beyond our combined abilities to obtain the results required by the customer. In leaving the foundry foreman he usually thinks that he is it, but if he would only join hands with the other factors at work for a successful foundry, he would, without a question of a doubt in his mind, conclude that he was only the "I," not the "It."

Next we will take the foreman patternmaker, a great man in his own way, in almost every case where such an important personage is re-

quired. Just fancy the foundry foreman entering the pattern shop with his usual, "Good Morning, What are you going to give us next?" and after several explanations from the drawings on the table or desk, should the foundry foreman suggest the making of the pattern such and such a way; then the usual argument begins. No matter how pleasant the beginning was it usually winds up with a fall out, both feeling hurt and invariably the worst way to get the job out is selected, if there is a possible opportunity to make it difficult or scientific, to show that the foundry foreman does not know what he was talking about. When the manager is on his round the story is told in two ways and it is safe to bet that neither has told the story right, having given only their own version, and caused worriment to the manager and anxiety to both combatants, for each wishes to win out in the argument.

Next we come to the chemist, and any one who has any connection with a foundry that has the good fortune to have a good one, knows what responsibility for production is his. Ordinarily he is the man to make soft castings out of hard iron and so forth, but many a sore heart both he and the foundry foreman would save themselves if they did not know quite as much as they do, in their own minds. This may be criticised as satire on my part, but that has been one point I have diligently tried to avoid, giving only a recital of the three individuals just as they are, if not always, at least very often; and this proves a great loss to the foundry owner, as it retards successful business operation.

Having made a careful study of the three parties herein mentioned, from practical experience with each in his part of the great work, I will try to lay out a plan for their mutual success and their employer's benefit.

As men they should meet together as often as possible outside the shop and get the best that is in each other to cheer each other's lives. In the foundry the work usually begins at the pattern shop, when an order is received there. If it is an old pattern, where advisable, a change can be made at very little cost, mutually agreed upon between the two foremen. They should make up their minds that they will not close a discussion until a satisfactory agreement is reached. If a new pattern is required, let them discuss all the ways to make the pattern practically, then discuss all the ways to mold the pattern, and then decide finally upon the way to be adopted, from the total cost of pattern and mold to produce the casting, which is the most important point from the foremen for the owner. This is the objective point sought, but unfortunately not obtained anywhere as often as should be if the success of the business was the first thought of each person interested.

One point should be mentioned here. Where a change in either foreman takes place, the new man is usually subject to much criticism. *His new ideas,* "This should be changed so and so," and so on, all of which may be quite justifiable on his part. But he meets opposition from the other side with "Oh, we have successfully made this and that for the last ten years or more this way." Such contention usually breeds contempt and poor results. The old foreman should make it his duty to immediately meet his new associate and have him feel as if he had at last met a man and a friend, then take his ideas and opinions in turn and discuss each one. It is by meeting with new ideas that progress and success is attained. Sometimes this method of mutual interchange of ideas is worked for a week or two, and then stops. It should continue all the time as it is the only condition to develop success for all time, and an exchange of visits to each other's departments, thereby interesting each other in both ends of the production of castings, ever keeping in mind that unity will accomplish great deeds. That the one is totally unfit for the other's position, for their respective training has developed one side of the business only. I only hope that every foundry foreman and foreman patternmaker will begin now and try this new method and make life hold out more sunshine for each, and receive the congratulations of their employers for their success.

Next we come to the foundry chemist. All foundries of any size should have one, and a central commercial laboratory should exist to accommodate all the small ones. It is now absolutely necessary to have the guidance and assistance of a chemist for every foundry foreman to accomplish the best results. This position must, however, be met by foundry foremen with a different spirit, for there exists too much antagonism to the chemist and his calling. It is as important to have the right material enter the cupola to produce a first-class casting from a first-class mold as it is to have a first-class core; in almost every case the foundry foreman can direct the making of the core but how can it be expected that he can apply himself successfully to the exact composition of the mixture which is as far

from his training as the making of a pattern. And yet, being less capable of obtaining results satisfactorily, he is usually opposed to the ideas of the chemist. If he would take the chemist in the spirit of an associate and give him every assistance possible to accomplish the best results, he would become indeed valuable to his employer and obtain pleasure thereby.

On the other hand, the chemist is a graduate from one or the other of the great technical schools of the country and his environments have been totally different from the foundry foreman's. In entering the foundry, it is very hard indeed for him to develop new ideas to suit that change that has suddenly taken place. This is where so many failures take place. With his better opportunities in life previous to entering the foundry it is hard to develop the required tact of association with the foundry foreman, as he may be old and set in his ways. Nevertheless to obtain the best results and find opportunities to do the best work every chemist should be the friendliest of associates to the foundry foreman, by meeting him on every point with mutual satisfaction before entering into any important undertaking. Finding out what is in the material to be used and the composition of the results of production are of a minor importance in themselves, but of great importance when combined with the other results obtained by the foundry foreman. If each foundry foreman and foundry chemist would commence not to attend to his own business solely, as is frequently the case, but to combine each other's business into one whole, we would indeed have a successful foundry combination.

A SIMPLE METHOD TO MOLD A PROPELLER WHEEL.

BY A. M. LOUDON, ELMIRA, N. Y.

The present era demands from every foundry owner castings at the lowest cost. To turn out the orders and keep the cost on the right side of the ledger foundry foremen are often taxed with phenomenal propositions. As many foundries in this country make propeller wheels of varying dimensions and as there are so many different ways adopted to make them, I have taken this opportunity to bring before the notice of foundry owners and foremen what I consider the best method. Many are daily making these castings under some other method, which cost much more and do not secure as perfect balanced a wheel as the method described.

Through the kindness of Mr. Thomas Sherriff, of Milwaukee, the writer had the privilege of photographing the rigging herein described for the making of the wheel molds, together with the opportunity of being an eye witness with other practical foundry men of seeing a 10-ft. wheel, four blades, molded and closed to cast, and could have seen the casting but our time was limited. This mold was made in dry sand by two molders and from the time the first cope was laid on the floor until the iron was poured into the mold the time elapsed was thirty-two hours total. Now I fancy I can hear some of you laugh at this statement, but I believe that if some of you here that are interested in the manufacture of propeller wheels would follow the method applied in that little foundry in Milwaukee, you will be convinced that it is about time that you quit the old fashioned way of sweep and loam mold.

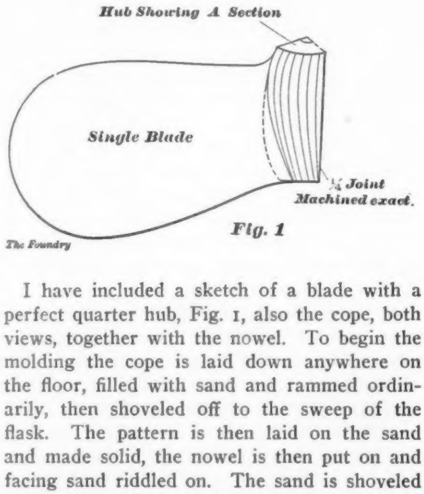


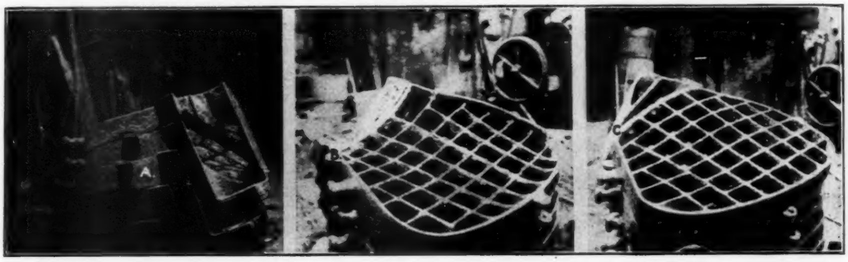
Fig. 1

I have included a sketch of a blade with a perfect quarter hub, Fig. 1, also the cope, both views, together with the nowel. To begin the molding the cope is laid down anywhere on the floor, filled with sand and rammed ordinarily, then shoveled off to the sweep of the flask. The pattern is then laid on the sand and made solid, the nowel is then put on and facing sand riddled on. The sand is shoveled on to a convenient depth and rammed, repeating until ramming is completed; the excess sand it shoveled off and butted, two wood screws are inserted into the pattern and secured to lift pattern and save moving cope; the nowel is then lifted off, rolled over and set down handy to the heap on a bed, the joint is made, one of the other copes is then put on and rammed up as an ordinary dry sand mold. The joint around hub is made perfect, shaving off one-eighth in. the total depth of hub, leaving the sand containing print and under full size of pattern for an exact circle

when closing up. The cope is lifted off pattern, drawn and placed back in false cope which was first used. The second blade is then rammed up as the first, using the same precaution for hub joint, then the third. Next the fourth nowel is rammed up, joint made and false cope shook out, as it is no longer required for any other purpose, the cope being rammed up and joint made as the other three were, cope is lifted off, pattern drawn and put away; on account of two molders working on this with a helper, when the last blade is rammed up the other three blades are finished ready for the oven and in a very short time the fourth is completed, the car loaded and put into the oven, where it is baked in one night. Next morning a level bed is struck off on a special part of the floor with a ring bedded on it. The flasks are then taken from the oven and brushed off, each cope going on the nowel it was rammed to anywhere on the floor. The first blade is then placed on the bed and a plum level is used on the joint of the hub, which sets the blade exact pitch and level. The second blade is then placed on bed, using the joint of the first flask and the plum level on the opposite joint and so on with the other two. The last one is set by size sticks which bring the hub to a perfect circle, and the quarters being true uprights, secures the wheel spaced to with one-quarter inch of exact quarter circle each. Then the molder who closes the mold, as there is only one doing this job with the helper, fixes up the hub joints while the helpers get the curbing around the flask and ram it up, covering the hub with a cake core and secured with cross bars and wedges. He can easily get his mold ready by two or three o'clock.

Trusting I have made this simple operation plain enough to every one, if not I will be pleased to answer any questions put to me on this subject.

Before closing I wish, on behalf of the American Foundrymen's Association and the trade, to thank Mr. Sherriff for his kindness in permitting me to bring this subject before you and in showing that spirit of giving to others what has been good to himself.



A SIMPLE METHOD TO MOLD A PROPELLER.

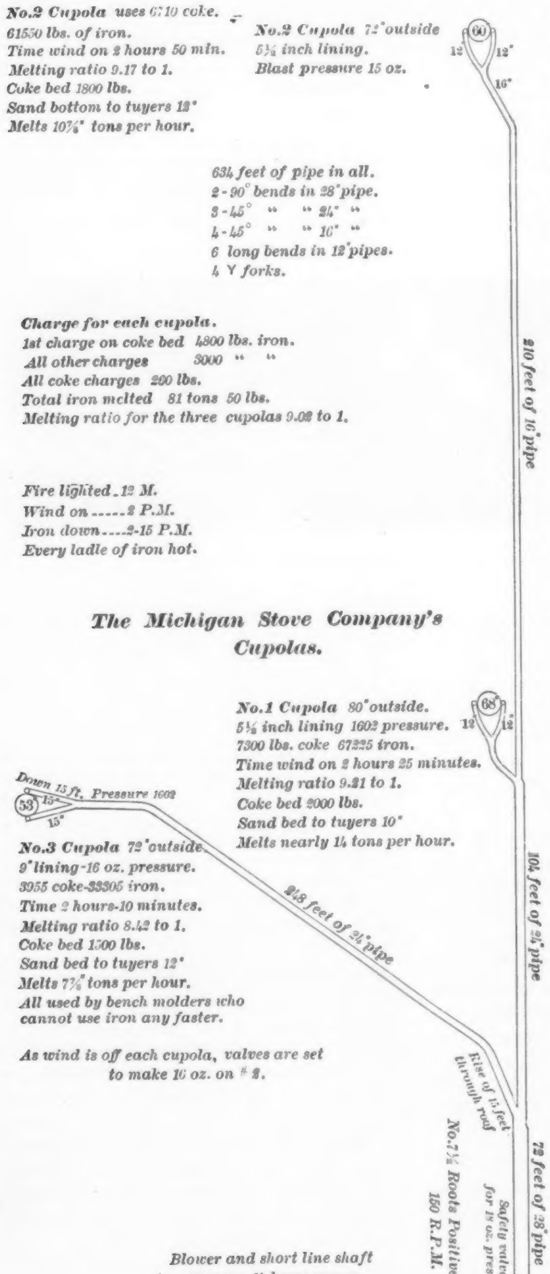
BLOWERS, PIPING AND CUPOLAS AT THE PLANT OF THE MICHIGAN STOVE CO.

W. J. KEEP, DETROIT, MICH.

In describing this plant and the performance of the cupolas and blower, it is with the full realization that ideal conditions seldom exist, and that each man must fashion according to his needs.

An independent blowing unit for each cupola with short piping, is an arrangement we would like to have, but which only a favored few possess.

In our case, the piping from the blower has been extended to meet the growth and increased demands of our plant. Until now we have three cupolas operated by one blower, under the following conditions: Starting at the blower end is a No. 7½ Roots' blower, running at 150 r. p. m. From there the air piping is carried overhead by two 90-degree bends in a 28-in. line, 72 ft. to a point where it branches with a Y into two 24-in. lines, one running 248 ft. to cupola No. 3; the other 104 ft. to cupola No. 1. From No. 1 with a Y branch begins a 16-in. line running 210 ft. to No. 2 cupola. All bends are long radius and wind boxes are supplied by two pipes on opposite sides, starting from a Y on the main line. The



sketch shows the general location of the pipe lines and cupolas.

There are butterfly valves in line at cupolas Nos. 1 and 3, so that cupola No. 2 may not be short of wind, and which are also opened to allow surplus air to escape when cupola No. 2 is operated alone. No. 3 is the point where the least air is needed and is where most of the throttling down occurs, because this cupola serves a snap flask shop, which cannot take care of the iron as fast as the normal operation of the cupola would furnish it.

As No. 3 cupola seldom operates over two hours, and with a very small heat, it is run at a disadvantage and cuts down the average efficiency of the entire plant.

In most of the data the results are for the plant as a whole, and while this shows unfavorably for Nos. 1 and 2, it represents the actual working conditions liable to occur in almost any large plant.

We find that our best results are obtained with a blast pressure at the cupola at from 16 to 18 ounces, for we get our fastest melting under those conditions, without sacrificing economy of operation. In order not to exceed 18 ounces a relief valve is placed at the blower to lift at that pressure. We have tried higher pressures and have found that with from 22 to 26 ounces there was no increase in the melting rate, as the chilling effect of excess air nullified the advantage of increased blast pressure. Up to 22 ounces there was a decided increase of output, but the best results were with a blast of 16 or 18 ounces.

The losses from friction in the piping are ½ ounce to No. 3, ¾ ounce to No. 1 and 1½ ounce to No. 2. At the beginning of the heat only Nos. 1 and 2 are on. Later No. 3 is started up and the pressure falls as low as 14 ounces at No. 2. This condition does not last for more than half an hour, when the pressure runs up to 15

ounces at No. 2 and 16 ounces at Nos. 1 and 3, at the end of the heat, with the dampers, this cupola getting 16½ ounces and melts very fast. The following is the record of an 81-ton heat in the fall of 1904 when the foundry was running to its full capacity:

AN 81-TON HEAT IN 1904.

Cupola	Outside Diameter	Inside Diameter	Coke Used	Iron Melted	Ratio Iron to Coke	Length of Heat	Tons Melted per hour
No. 1	80"	68"	7300	67225	9.21 to 1	2h—25m	14
" 2	72"	60"	6710	61550	9.17 to 1	2h—50m	10⅞
" 3	72"	53"	3955	33305	8.42 to 1	2h—10m	7⅞

Totals, 81 tons 50 lb. iron. 32.75 tons per hour. Ratio 9.2 to 1. Air displaced by blower per ton per hour 22,800 cu. ft.

For stope plate it requires close attention to avoid dull iron when the ratio is above 9 to 1, and the following are average records. When more coke is burned melting is slower:

A 75½-TON HEAT IN FEBRUARY, 1905.

Cupola	Coke Used	Iron Melted	Ratio	Length of Heat
No. 1	6900	63430	9.0 to 1	2h—55m
" 2	6450	59250	9.2 to 1	2h—55m
" 3	3640	28270	7.8 to 1	1h—50m

75 tons 950 lb. iron. Ratio 8.86 to 1. Air 25,380 cu. ft.

1905	March 1	March 2	March 4
Total Coke Used....	16950	16970	16660
Total Iron Melted..	75 tons 10 lbs	74 tons 1740 lbs	73 tons 190 lbs
Ratio Iron to Coke..	8.8 to 1	8.8 to 1	8.7 to 1
Tons Melted per hr	28.8 tons	28.07 tons	28.00 tons
Cu. ft. of Air per Ton per hour.....	25500	26400	26400

On March 8, 1905, on account of a funeral of one of the employes, No. 1 cupola was run alone with an air pressure of 17 ounces.

The molders could not pour fast enough to take the iron as fast as melted and it was therefore neccssary to reduce the blast at times. Under these conditions 33 tons 960 lb. of iron were melted at the rate of 13.4 tons per hour with a ratio of 9.2 to 1.

As the average of the last four heats in No. 1 cupola was 11 tons per hour, the increasing of the blast 1½ oz. has increased the melting 20 percent.

HORSEPOWER REQUIRED TO DRIVE THE BLOWER AT VARIOUS PRESSURES.

Pressure at Blower	Indicated Horsepower to drive Blower	Theoretical Horsepower to drive Blower	Per cent Efficiency of Blower	Friction
13 ounces	50 I. H. P.	45.23	90.4	6.9
18 ounces	72 "	62.48	92.0	8.0
23 ounces	87 "	80.00	87.0	13.0

The engine was indicated by an expert. 18 ounces at the blower would produce the normal pressure at each cupola.

The friction of a short countershaft and belt are included in these figures. As the relief valves of our blower are set for 18 ounces and our pressure varies from 13 to 18 ounces, it is fair to assume 64 as the average horsepower consumed during one melt. As the tonnage with three cupolas is 28½, the horsepower per hour required under our conditions is $64 \div 28\frac{1}{2} = 2.25$, and the air displacement per ton of iron per hour is 26,220 cu. ft. per hour, instead of 30,000 cu. ft., as usually allowed.

As a pound of carbon requires about 11 lb. of air for combustion to CO^2 and 13 cu. ft. of air equals 1 lb., therefore 1 lb. of coke should require 143 cu. ft. of air. The coke averages about 5,650, requiring theoretically 28,500 cu. ft. of air per hour.

Wishing to know what the makers would recommend for our work, as the most economical installation, we find, in spite of our long pipes, and air actually wasted, when Nos. 3 and 1 are shut down, that we are still well within what would be ordinarily expected in an ideal arrangement of independent blowers and motors for each cupola, with consequent decrease of pipe friction.

The makers recommended as follows:

Cupola Blown	Cu. Feet Air Displacement per Minute	Horsepower	Tons
No. 1	7000	30.5	14
" 2	5400	23.5	10⅞
" 3	4000	17.5	7⅞
Total......	16400	71.5	32¾

Allowing 20 percent for friction of blower and motor, we get 90 horsepower, or 2¾ horsepower per ton, against 2¼ actually required.

On the above basis of air the friction losses figure out 1 ounce to No. 1 cupola, 3.1 ounces to No. 3, and 6 ounces to No. 2. On an allowance of 24,000 cu. ft. per hour per ton of iron the friction to No. 1 cupola is .9 ounces, to

No. 3, .55 ounces, and to No. 2 cupola is 2.50 ounces.

The actual loss as stated before is from $\frac{1}{2}$ to $\frac{3}{4}$ of an ounce to Nos. 1 and 3. It is from $1\frac{1}{4}$ to $1\frac{1}{2}$ ounces to No. 2, showing that our piping is of correct size to Nos. 1 and 3 but too small to No. 2. It would be better to continue the 28-in. pipe to the fork at No. 1 and make it 20 in. or 24 in. to No. 2.

The data presented here represents as near as possible actual running conditions, and our plant could be improved upon by independent units for each cupola with shorter piping, thus avoiding the waste of air when Nos. 1 and 3 are down. This could be done by reducing the speed of the blower, but as we are fixed we have to use constant speed.

However, as we are now getting iron as hot and as fast as we wish it, there is no object in increasing the blast pressure.

We would be very much interested to have the records from a plant where the arrangement is similar to ours, and where a fan is used instead of a rotary blower.

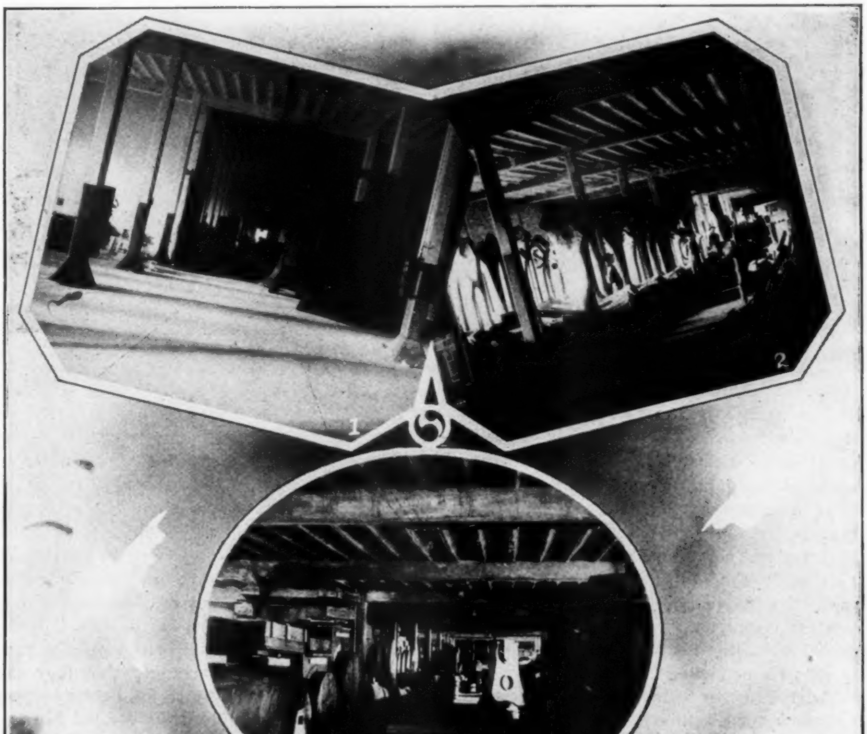
CARE AND STORAGE OF PATTERNS.

BY H. M. LANE.

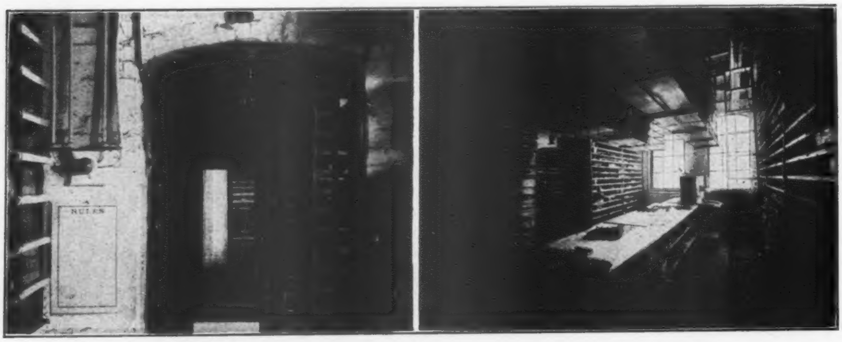
One of the most serious problems that confronts any manufacturing concern is the storage of patterns and the records for the same. All patterns are to be divided into two classes: wood and metal. If the concern uses metal patterns entirely the storage can be much simplified, as the metal patterns can be easily protected against fire loss, and hence the storage of this class of patterns will be considered first.

Metal patterns are, as a rule, of comparatively small size. Very small or thin patterns, which are used in connection with match plates, can be stored in fireproof vaults or rooms. Very frequently, however, wooden shelving is used in such vaults, though when possible it is always to be avoided. Very strong, and not exceedingly expensive shelving can be made up from light angle iron and sheet iron. It is needless to say that the pattern vault should always be kept dry for the protection of patterns, and under such conditions the iron shelves and supports would last almost in-

VAULT FOR METAL PATTERNS WITH WOODEN SHELVING AND SKYLIGHT IN ROOF.
INTERSTATE FOUNDRY CO., CLEVELAND, O.



INDIVIDUAL ROOM SYSTEM OF PATTERN STORAGE, SHOWING METHOD OF TAKING CARE OF DIFFERENT CLASSES OF WORK. ALLIS-CHALMERS CO., WEST ALLIS, WIS.

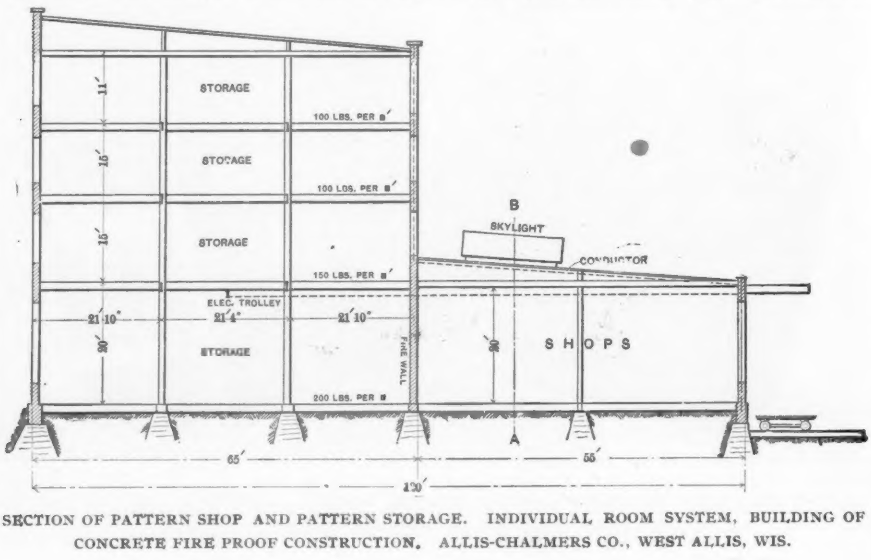


FIRE PROOF VAULT FOR METAL PATTERNS WITH METAL SHELVING AND OUTSIDE WINDOWS. YALE & TOWNE MFG. CO., STAMFORD, CONN.

definitely. A vault of this kind having fireproof walls, roof and door, and provided with metal shelving, is undoubtedly the best possible arrangement. To cheapen the arrangement somewhat, many have substituted wooden shelving for metal shelving. If the vault is thoroughly fireproof and there is no opportunity for the shelving to be set on fire, such a vault is certainly very valuable; and it is probable that the risk of fire from the shelving is almost a negligible factor.

To still further reduce the cost of the storage some manufacturers have located the storage in a building apart from the other structures, and arranged with no windows in the side walls. The shelving is of wood and the roof of some slow-burning construction, usually covered with slate or metal. Light is obtained from sky-lights in the roof. Such an arrangement as this is undoubtedly a great protection, but care should be taken not to store combustible materials in the vault, such as alcohol, gasoline, etc., as the ignition of a can of such material might destroy the contents of a vault in a very short time. If no such building is provided for the metal patterns the storage shelves should be so arranged that they can be readily protected by a fire-fighting apparatus, and they should also be located in some part of the plant where the fire risk is a minimum.

As a rule, where metal patterns are used in



SECTION OF PATTERN SHOP AND PATTERN STORAGE. INDIVIDUAL ROOM SYSTEM, BUILDING OF CONCRETE FIRE PROOF CONSTRUCTION. ALLIS-CHALMERS CO., WEST ALLIS, WIS.

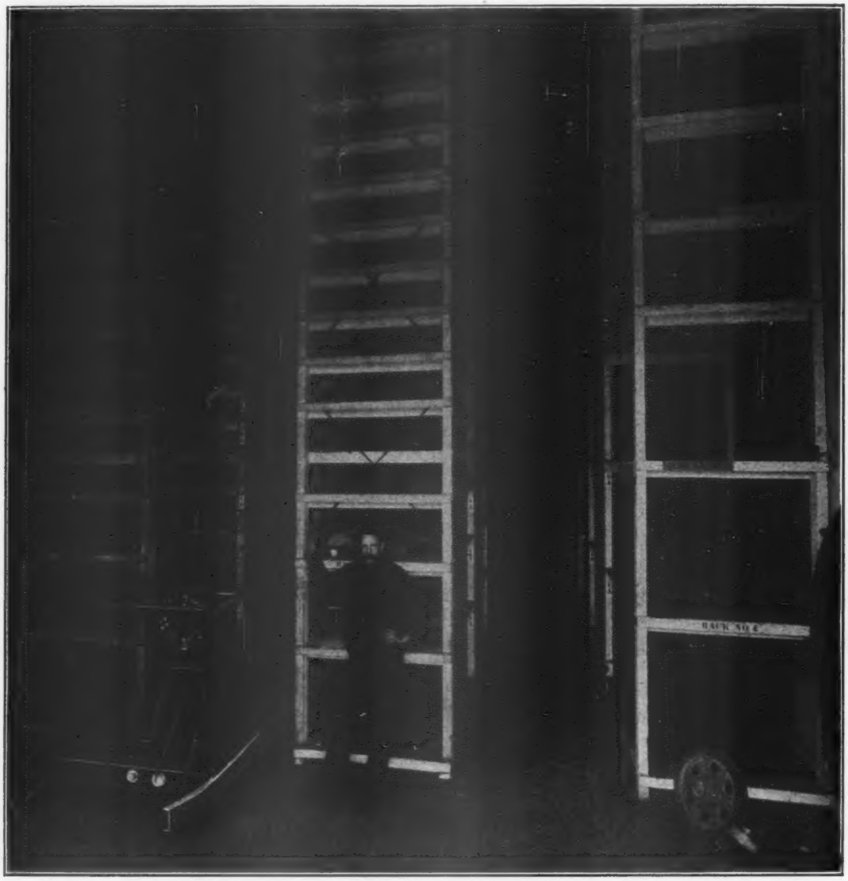
INDIVIDUAL ROOM SYSTEM OF PATTERN STORAGE WITH SLOW BURNING CONSTRUCTION AND FIRE WALLS. GENERAL ELECTRIC CO., SCHENECTADY, N. Y.

stove plate, hardware and similar factories, the patterns with their matches do not take up much space, and hence a very large number can be stored in a comparatively small space. Where special molding machines, equipped with large patterns, are used, it becomes necessary to provide stronger and larger shelving, and in some cases the large pieces must be kept on the floor of the storage building.

In the storage of wood patterns, several very different factors enter to complicate the problem. First, the patterns themselves are highly inflammable; second, wood patterns are usually very much more bulky than metal patterns, and hence require larger space in the storage; third, wood patterns absorb moisture during molding to a greater or less extent, and if they are then placed in a cold storage room, in the winter moisture freezes and injures the joints and surface of the pattern and hence a pattern storage for wood patterns should be provided with some heating system. It is also necessary to heat the metal pattern storage for the benefit of the man who takes care of the patterns, as no man can do work in a cold room.

In the case of wood patterns all that can be done in the construction is to minimize fire risk. Different parties have taken different methods for accomplishing this. Among the methods of construction of pattern storage

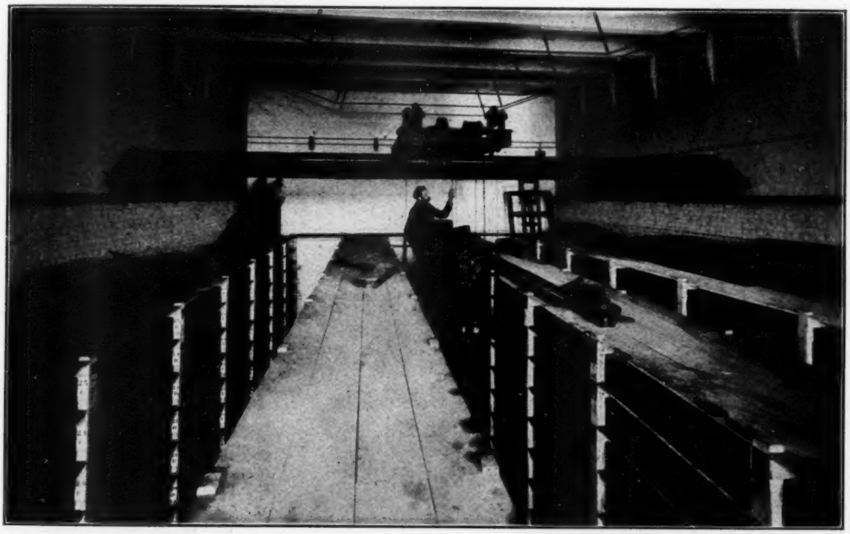
SHELVING AND DRAWERS FOR THE STORAGE OF SMALL PATTERNS.



FOOT OF PATTERN SHELVING SHOWING HOIST, INDIVIDUAL VAULT SYSTEM.
BROWN HOISTING & CONVEYING MACHINE CO., CLEVELAND, O.

buildings in regard to fire risk the following may be considered: First, in regard to protection there are the individual room and the individual vault systems. In the first ordinary pattern shelving is used, the rooms are provided with fireproof floors, the windows, if any, with fireproof shutters, and the doors with self-closing fireproof doors; these doors are held open with cords and fusible plugs or couplings which would be released very quickly if exposed to any heat. The object in this system is to prevent the fire's spreading through the entire storage and to, as far as possible, smother the fire in the compartment in which it breaks out. This system is generally used in connection with the sprinkler system. Of necessity the pattern shelving is not very high in such a storage room, on account of the fact that the patterns are all placed in position by hand from short ladders, and hence the individual units are rooms from 60 to 100 or more feet in length, usually from 60 to 80 or more feet wide and from 15 to 20 feet in height.

In the other system the individual rooms or units are made narrow but very high; a crane is used for placing the patterns into or taking them from the storage, the crane being arranged to travel over the entire room so that the operator may carry his cage or platform in between any of the sets of shelving, and thus reach any point of the storage system.



TOP OF PATTERN SHELVING SHOWING CRANE WITH CAGE ON HOIST, INDIVIDUAL VAULT SYSTEM. BROWN HOISTING & CONVEYING MACHINE CO., CLEVELAND, O.

Such rooms can be made practically air tight; the ventilators at the top being provided with covers suspended by fusible couplings which are dropped at the least indication of fire. In this style of storage the sprinkler system would be of little avail.

In both the systems so far described every possible precaution is taken to enable those in charge to extinguish a fire, should one start; usually, however, these buildings are arranged for the use of artificial light, which in most cases is furnished by the use of incandescent lights. Such wiring naturally introduces fire risk. To minimize such fire risk and at the same time to reduce the labor of placing the patterns on or removing them from the shelving, at least one prominent manufacturer has constructed a pattern storage using slow-burning mill construction and having a head room of not to exceed 8 feet, so that a man standing on the floor could reach any of the shelves.

To minimize fire risk no artificial lights of any kind are allowed in the building, and all patterns are taken into or out of the storage during the day.

Other manufacturers have sought to minimize the fire risk in many ways. In some cases the inflammable character of the material has been recognized and only a thin wooden roof of light construction used; the idea being that such a roof would burn off quickly and give free access to the fire for the firemen. A large number of pattern storages have been constructed one or two stories in height, without any outside windows; all of the light being derived from a skylight; the idea being that the lower part of the building could be shut up tight and a fire smothered out. The particular form of construction of the building must of necessity depend largely upon the means of the company owning the plant, and where sufficient capital is not available it is often necessary to use the simplest kind of frame structure. There is no place about a manufactory where there is such an opportunity to display fads or ride hobbies as there is in connection with the care and storage of patterns, and it requires good judgment and careful planning to be sure that the best system is installed. There are a few points in connection with the subject of pattern storage, however, which may be called axioms.

First, no matter how many men are allowed to take patterns from the storage, only one man should be allowed to return them and he should be held responsible for every pattern. Second, where only a limited number of small or medium-sized patterns have to be cared for it is foolish to install any hoist or elevator system for handling patterns, as in most cases

EXTERIOR OF PATTERN STORAGE SHOWING ISOLATED BUILDING SYSTEM WITH LOW CEILINGS AND THE ELIMINATION OF ALL POSSIBLE FIRE RISKS. NORDBERG MFG. CO., MILWAUKEE, WIS.

the attendant has ample leisure to put them away, and in many cases he can carry them upstairs cheaper than they could be taken up on an elevator, which would ordinarily stand idle 99 percent of the time.

Third, whatever system is in vogue, some provision must be made for taking care of the dead patterns; in other words, there must be a graveyard.

Fourth, wood patterns must never be stored where they are subject to rain or snow, or even where they are subject to freezing temperatures. The reason for the latter statement is that moisture in the surface of the pattern will be frozen and injure the surface or finish. This freezing will also often open the joints.

FOUNDRY AND PATTERN SHOP STANDARDS.

BY WM. H. PARRY, BROOKLYN, N. Y.

It is an old maxim that molders and patternmakers never agree as to the means each should employ to facilitate the work of the other.

That this state of affairs will always exist, in spite of the well-meaning action of societies in appointing standardizing committees, cannot be denied, but by this very action, a much better basis of understanding can be brought about. The conditions which surround each of the interested parties will be better known, and thus a start in the right direction made.

When we speak of standardizing everything in foundry and patternshop, it is not to be by means of hard and fast rules, for this is bound to fail, because of the constantly varying conditions along these lines of mechanical endeavor. Much, however, can be done by the observance of the fundamental principles that govern a fair proportion of the work accomplished in both departments of the industry.

In loam work it is often found that a wide divergence of opinion exists on many points pertaining to that branch of the foundry trade. Chief of these may be mentioned the proper angle of the sides of in-

PATTERN STORAGE WITH LIGHT WOODEN ROOF AND SKYLIGHTS.
BUFFALO FOUNDRY CO., BUFFALO, N. Y.

and-outside seats, their depth, and the diameter of spindles used. Some foundrymen insist on having sweeps made for seat plates, such that for every inch of depth, one-eighth inch angle must be allowed. This certainly shows good results. Other foundrymen, however, insist on having but one-sixteenth inch for this purpose. Still others demand three-sixteenths of an inch, and the severely technical foundry superintendents are still abroad who require their angle given in degrees and minutes. Yea, sometimes even in seconds.

Now this is all very pretty, but unfortunately it adds to the already chaotic conditions of the shop. Right here it is suggested that from an all around experience of many years, one-eighth of an inch is about the proper angle.

Next we have the old controversy of the depth of core and outside seat. The ratios differ from one inch in depth of seat to one foot in height of casting, regardless of diameter; to one-half inch of depth to one foot of height. This can easily be settled by simple formulae which suggest themselves, and have been in successful use for some years. For instance, with the diameter D, and the height H, the formula

$$\frac{D + H}{2} = Y$$

is applicable for castings approximately equal as to height and diameter, and

$$\frac{D + H}{4} = Z$$

is applicable where the diameter is twice the height. It can readily be seen that sufficient area of contact is given to insure rigidity and proper alignment.

The diameter of loam spindles are rarely the same in any two jobbing foundries, often varying from one and one-half to four inches in diameter; and to suit these deplorable conditions sweeps are made by the patternmaker to the center line, with the understanding that the foundryman will

A GOOD METHOD OF STORING GEAR PATTERNS. WELLMAN-SEAVER-MORGAN ENGINEERING CO., CLEVELAND, O.

trim them to suit the size of the spindle. It works fairly well for a time, though it increases the foundry cost and offers a fine field for incorrect work for the first molder, not to speak of the next one who tackles the job, and whose spindle is a little larger or a little smaller than the one used by the first man.

It may be difficult to standardize matters here, but at least to evoke discussion, it is suggested that for castings whose diameter and height do not exceed five feet, a two inch spindle should be used. Over five and under ten feet, use a three inch spindle; over ten and under fifteen feet, a four inch spindle, or some sort of an arrangement of this kind which will give the patternmaker a line on which to work, so that he can make his sweeps and loose pieces accordingly, and not thrust work upon the foundryman, which should be done in the pattern shop in the first place.

The question of draft has undoubtedly been a bone of contention from the very beginning of the art of making patterns and casting metals. It does seem that an agreement can be reached between the disciples of both trades, if a proper spirit is manifested. If the spirit of give and take be manifested, a rule can surely be agreed upon, such for instance that one degree of draft be always allowed for drag and cheek, and never less than three degrees for cope. What an advance there would be in the right direction, if this were an accomplished fact, to say nothing of the clearing of the atmosphere about the foundry when such things as back draft, no draft, or very little draft, come up for ventilation.

The angle of the sides of core prints is a point worthy of our serious discussion, as there are but few foundries and pattern shops wherein there is an agreement on that matter. For all around work this angle varies from five to fifteen degrees a side. In this age of core-making machines there seems to be a peculiarly opportune time to make a stand for what in the estimation of the members of the American Foundrymen's Association, is the right angle for all cope prints, whether they are small enough to make on the machine, or big enough to be made by strickles. The angle should be determined for all time.

The molding machine has come to stay,

and to keep up with the procession, the size of flasks to be used on standard makes is, and is going to be, a serious problem for the patternmaker who has to fit up work for different styles of machines, whose flask sizes differ as well. There should be standard flask sizes, such as 10" x 10", 12" x 12", 12" x 18", 12" x 24", etc., etc. By this arrangement patterns could be fitted up in one city, and cast in another. The fitting up of patterns at the foundry would be obviated whereas this must now be done on account of the many manufacturers of molding machines.

Mechanical engineers, who decorate their drawings with mandatory orders to cast *off* this, or two *of* this, or sometimes two *as* this, apparently need a little help in the ordering of castings. So why not simplify the matter by using symbols, to which they are proverbially prone, say such as Ct 2, and thus destroy at one fell swoop the everlasting controversy whether it is two off, of, or as. Again, if two castings are to be made from the same pattern, so made that by the transposition of a loose piece or two, it makes right hand or left hand work, they might instead of the usual instructions to Cast One Right and One Left, use the same symbols, Ct 2 R & L, or Ct 1P, which being interpreted means Cast One Pair. In this way less time is consumed in writing orders for castings, and an understanding is also reached between foundry and pattern shop.

The varnishing of patterns so that prints show a contrasting color, and spots sometimes occupied by loose pieces also show still another contrasting color, is, so far as the pattern shop is concerned, a very pretty way of decorating a pattern. The trouble is, that after making a few castings, all colors look alike, and it has happened that a loose piece has been forgotten here and there, and consequently costly castings have been returned minus these protuberances, all because the molder of the pattern may have been color-blind. If, instead of contrasting colors, the prints are stamped *Print,* loose pieces, and the spaces they belong to, stamped L. P. , L. P. , L. P. , L. P. ; and finished surfaces F. F. F., care being taken never to use the letter F to designate a loose piece; it will be found that better castings result with less pattern shop expense.

There are many other practices that could be improved upon by standardizing and it is to be hoped that patternmakers and foundrymen alike will cast their prejudices aside and thus make possible for both to dwell in harmony in the future. For this purpose I respectfully request that a committee be appointed by this Association to study the standardizing of patternshop and foundry practices, and report recommendations from time to time to this body.

BETTER CONDITIONS IN THE PATTERN SHOP. AN EXPERIMENT THAT SUCCEEDED.

By J. L. Gard, Denver, Colorado.

Anything that will tend to better the condition of the employee should also benefit that of the employer. If we contrast the condition of the worker of today with that of fifty, or even twenty-five years ago no one will question that the conditions under which he works are very much better, both as to the place in which he is employed and the hours he spends in it; and I also believe that the employer is under better conditions. Therefore what benefits one must of necessity benefit the other.

The prosperous manufacturing establishment is not the one that tries to get as much as possible out of their help for as little pay as they can give them, and with as little as possible in the way of good conditions for their employees, by good conditions, I mean light places that the sun gets into, sanitary surroundings, tools and appliances that produce the largest amount of work and make it easiest for the men to do it. Superintendents and foremen that treat men with justice and firmness, and that are responsible and insist on some measure of responsibility from those under them. The question of being responsible is what makes a man a superintendent, a foreman, or only a day worker. Irresponsible men seldom get to be in charge of work.

Many of you have observed the tendency of the average man to shirk responsibilities of any and every kind, with any sort of an excuse, and I think this is the reason that he remains an average man. This tendency can be outgrown; but how much better it would be to teach a feeling of re-

sponsibility to boys learning trades or just starting in life.

Then there is the man whose work you never feel at all sure of, it is as likely to be wrong as right; he lays it to a poor drawing, insufficient orders, or anything or anybody except himself. The man that is not accountable for himself cannot hope to rise very high. The hardest battles we have to fight are with ourselves, the man that cannot conquer himself cannot hope to overcome difficulties, I am inclined to the belief that we all get just about what is coming to us in this world; and also believe that without work a man will accomplish little, and that he will be little known except for his laziness. On hearing the complaints of some men about the hard conditions under which they are employed, I often wonder how much they have to do with making them as they are. No doubt many of you have observed that the man that complains the most is generally the poorest one you have.

I had long thought that some way ought to be devised by employers to have their workmen co-operate more with them. The interests of both are mutual and antagonisms pay no one. And that some way could be found to reduce the percentage of errors in our pattern work. With this idea in mind; I, about a year ago proposed to my employees to reduce the working day to eight hours (we were working nine at the time), and to let the pay remain the same, in return they were to be responsible for the correctness of their work, and were to correct all errors that plainly belonged to them at their own expense. They were, in so far as possible, to try to do as much in eight hours as had been done in nine before. While I did not expect to get nine hours work in eight hours, I at least wanted them to try, and I also expected that the fact of more care being necessary on their part to prevent errors would have some influence on the amount of work they could do, as it takes *some* time to be careful. But I believe that it is better to use a little more time to do a job right the first time. Which belief they shared with me after a short trial of the new system.

I realized that to make a success of the plan there must be honesty as well as fairness on both sides, as what was fair for one should be as fair for the other. Also that some system of orders must be used so that there could at no time be any question as to whom the responsibility belonged. If any carelessness was permitted in this respect it was almost sure to lead to disputes and hard feelings, for the usual workman is rather prone to think that he is getting the short end of the proposition in any event. Unless there could be a feeling of harmony on both sides and a belief that each one would act with justice toward the other the plan could not succeed.

If a sketch or drawing was not plain, or an essential dimension was omitted, I tried to impress on them that it was much easier as well as cheaper to ask questions, than to do the job over again for want of easily obtained information, my idea being to assist them to get a thing right the first time it was done. I said that "if you do not know, and do not try to find out, the error belongs to you."

If a verbal order was misunderstood, what evidence was there to show that the order was given at all, for surely one man's word is as good as another's until proven otherwise. With this idea in mind; when anything was done wrong for which I had given a verbal order; which it was sometimes impossible to avoid; I would when I discovered it at once inquire of the workman what I told him to do. It would then develop whether I had told him the wrong thing; whether he had misunderstood; or whether the error was of his own making. It surely is easy to know that one did not say a certain thing when that thing is not reasonable and at variance with common sense, so that I have not found it very difficult in most cases to place the error where it belonged.

Even with all care taken there have been cases where a difference of opinion has arisen, but with a spirit of playing fair we have generally succeeded in adjusting differences. It at times required a giving way of one's own opinion as to what was thought to be right. I think that it often requires more courage to give in than to fight. I have had men with me that thought it very nice to get the short hours, but they would not play fair, they believed it more blessed to receive than to give. They had the alternative of working nine

hours at the same pay or of quitting the job.

After more than a year's trial of this plan I have made it a success with the force that I keep constantly employed. It has helped them to be more careful and they are more to be depended on. They have gained a feeling of responsibility, and that is a great deal toward being a reliable workman. The percentage of errors has decreased to a very great extent, as anything that affects one's purse is bound to be considered.

While I have not tried to keep any record of the saving in dollars, I know there is economy in a proper working of the plan. If I had gained but one thing, of freedom from worry of paying twice for a correct job, which often takes all the profit out of work; I should consider it a success. To attain this degree of success, I have found it necessary to carefully keep track of each job being done, and have in mind at all stages of a piece of work just what had been done and what was being done. This was necessary to have them see that we meant to have the agreement lived up to. My aim has been to prevent errors, that we may have few to correct. I believe that it is easier to prevent errors than it is to correct them; and I am sure that it is cheaper. Where one pays for correct work only, and pays by the hour, one can afford to pay more per hour, and that is what the system means to the workman. Under any system where the employer pays for all work done, be it right or wrong, some one is bound to pay twice as much as they should for *some* work, it is paid by either the shop owner or the customer.

I think that a man who is willing to be accountable for what he does, is a more valuable man than one that is not accountable. I believe he is not only more valuable in a monetary sense, but also more valuable as an associate. The careless workman can very easily take all the profit out of a contract job. When you get a man to feeling responsible he becomes a better citizen.

While on this subject of being responsible I want to speak of the influence of some labor organizations on many workmen. They do not get enough education along the line of the indisputable fact that a man must work for what he gets unless he steals it. As far as I have been able to understand their motto, it is: "We will give as little work as possible for as much pay as we can get. There is no justice that concedes any privileges to the owner of a business. We have a monopoly on the privileges. If our employers will let us run his business we can do it splendidly until pay day comes. We will then let him have it for a day so that he may think it belongs to him."

It has always seemed to me that the greatest weakness of these organizations has been the desire to make the good man carry the poor and shiftless one. I fail to see the justice of compelling the man who is ambitious and willing to work carry the burden of the man who does not care and does not try to do his duty. If a good man can make no more than a poor shiftless one, what incentive has the good workman to try to do any better? It is a fact that more people work for the money they get, than do so for the glory there is in it.

Many of you have probably had men with you that did not stay long, some because they did not want your job, and others you did not want. I am reminded of one of the latter kind that I once had for a day. I put him to work on his representation of what an excellent workman he was. The first job I gave him was one that did not require much care, this he did passably well; I then gave him a better one to do. Going to look at it later on I said that it was not as good as I expected and that I thought he could do it better, and that I wished he would see if he could not better it so that it would go. Shortly before quitting time I went to have another look at the job, when I found it worse than before. I then expressed my doubts about being able to use it at all; in fact, I think I said that it was no good, and that I thought he wasn't good enough for the job. So I gave him what was coming to him and said that I would not expect him in the morning. On arriving at the shop the next morning I thought I would have another look at the piece and see if I could fix it up and use it, but it was not to be found any where. This necessitated making a new one, what I had paid for work on the first one being a dead loss. A day or two later the man came to get his tools,

and I asked him what had become of the pattern that he had made? He replied that as I had said it was of no use he had put it in the stove. I then asked him if I hadn't paid him for making it. He said that I had. Then I asked to whom it belonged? He said that it belonged to me in that case. Then I wanted to know if he was in the habit of burning up the property of others. I told him that I thought that if he was honest he would return the money I had paid him for making it. He offered as an excuse that he did not have that much about him, I told him to bring it in or send it when he did have it. That was about two years ago and I am still waiting for it. He not only got the money for the job but he got the job too. This is given as an illustration of the way some men expect to deal with you. It may have just happened so, and not indicate real conditions, but I have been up against these propositions pretty often. I do not attempt to explain it, because I do not think that I could do so. These are the kind of men that I have failed with on the eight hour system. The only way to do with them is to watch them very closely and use a club, or even better, don't have them about you at all. Your financial condition will show up much better at the end of the year.

It seems to me that a plan such as I have outlined is an advantage over the one in general use. The employer gets a better class of men about him; as men that are willing to do their part without shirking must be better worth having. He has a freedom from much worry that comes to the usual employer. A careless workman cannot get all there is in a job and more beside. I believe that a shop can be run with very much less personal friction, and the more friction the less power there is left to do work with, and that is what a shop is run for.

I also think that this plan is better for the workman, for the reason that he is able to make more per day, or, as much in a shorter day. He is paid for what he does, but not for what he doesn't do. He must grow into a careful dependable workman, with the natural result that he is able to get better pay than if he was not reliable. He has less trouble about his work and he naturally feels better satisfied with his place in the world.

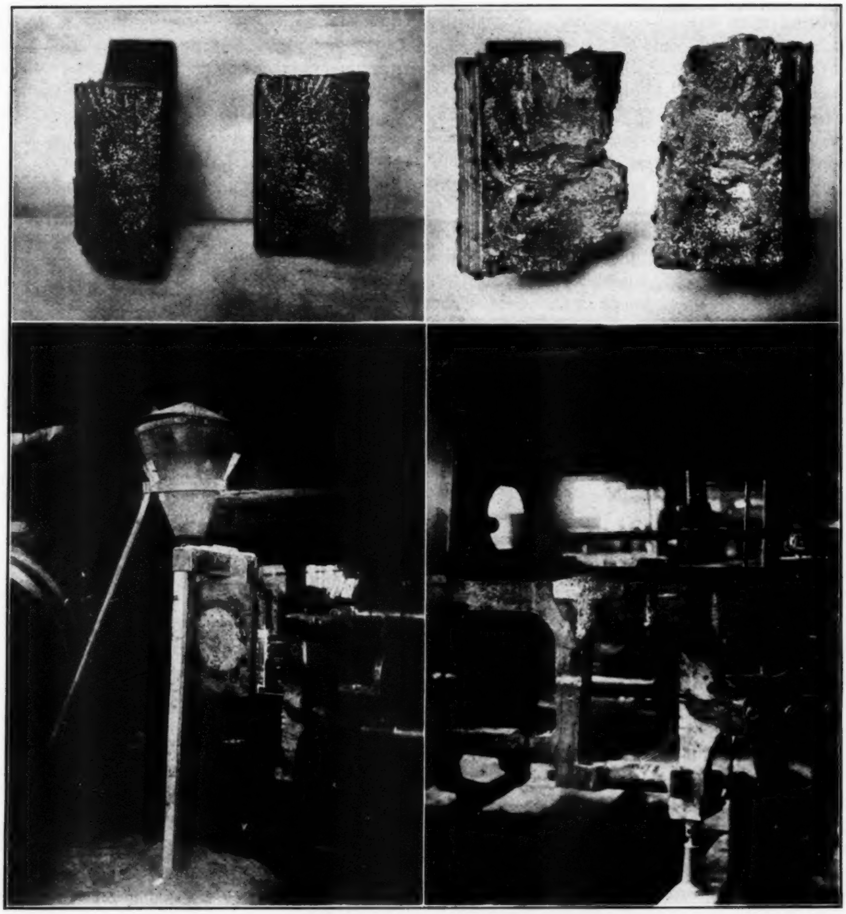
I have attempted to give you some of the experiences that I have had in a trial of this plan, I have had many more, but time would not permit the telling of them. Some of them reflect a great deal of credit on the workmen themselves. This idea was proposed in a spirit of mutual helpfulness and carried out thus it has not been a failure. I think that every effort we use to help others is never wholly lost.

THE USE OF THERMIT IN A RAILROAD SHOP.

BY JAS. F. WEBB, OF ELKHART, IND.

Thermit is quite new to the majority of us. The first the writer heard of it was about a year ago and since that time he has made a study of it and below is given the experience he has had with it in making several repairs in railroad work. Mr. Autz, general foreman of the Lake Shore railway shop at Elkhart, Ind., has been making some experiments with thermit and the writer assisted him.

The first test was a draw bar of wrought iron, the piece being 2½ x 4¾ in. It was cut in two and welded. We used an ordinary iron flask with openings cut in the sides to let the bar stick out. The size of the flask was 14 x 18 inches, both cope and drag being 8 in. deep. For the sand mixture we used 50 percent fire clay and 50 percent common builder's sand wet with water. The mold was well vented so as to allow it to dry easily. It was dried in a furnace used to melt brass. By placing the mold on top with the bottom side down at first and leaving it over night. The next day the furnace was fired up once more, the mold turned face down and brought to a red heat. The bar was cleaned for four or five inches each side of the break so as to remove the rust. It was then heated to a cherry red and placed in the mold, which was almost red hot. After closing the mold, all small cracks were well filled with soft fire clay so as to prevent run outs. A collar was cast around the break about ⅝ in. thick and 1¾ in. wide, the object of the collar being to give the metal an opportunity to run around the bar so as to melt the surface of it, thus forming a perfect weld. If it were not for the collar, the ends of the bar would not be sufficiently heated. The mold was gated from the bottom, so that the metal would strike the bottom corner of the bar first, run through under it and gradu-



1 AND 2 FRACTURE OF THERMIT WELDS, 3 CRUCIBLE IN PLACE FOR A WELD, 4 THERMIT WELD.

ally rise on all sides at the same time. The gate was at an angle of about 15 degrees. The riser was quite large, being 6 x 9 in. at the top and tapering to 2 x 4 in. at the casting or weld. We used a skim gate to catch the slag, as there is about three times as much slag as iron when measured by volume. The slag also is not as liquid as the iron. The skim gate connected from the pouring gate to the riser. We all know that if such practice as this were discovered in a gray iron foundry the molder guilty of it would be looking for a new job soon. The connection between the pouring gate and the riser which forms the skim gate was about 2½ in. from the top of the casting or weld, the opening being 1¾ x 1¾. The writer has found it good practice in this class of work to have a skim gate extend almost up to the top of the pouring gate and riser so as to avoid any tendency of the slag to pass down into the mold.

In this first weld we used 16 lb. of thermit, the collar and the space between the weld together requiring about 22 cu. in. of metal. After breaking the piece, it was found to be full of blow holes so that it broke easily under the screw press operated by hand. In this case the thermit was put in a crucible in the usual way, the ignition powder being placed on top and the metal being tapped as soon as the reaction ceased, which the writer thinks is not good practice. Better results are obtained by

waiting from five to ten seconds, to give the slag a chance to come to the surface.

On the second test, which was made on the same sized bar and in the same way, we used 20 lb. of thermit and got a great deal better weld, with a very good grain and fracture. There were, however, a few blow holes at the top and near the center of the weld, as shown in the half tone reproduction Fig. 1, which is a cross section of the bar after it was broken at the weld. These bars had the collars machined off, together with the riser, so as to make them break at the weld. The second test piece was put on a hydraulic press and required 50 tons to break it, with supports 20 in. apart. The fracture was nearly straight across. In the second test the metal tapped itself about the time the reaction ceased, the reason being that the metal disc used in stopping the bottom of the mold is a little convex on one side and had been placed with the convex side down so that it did not have a perfect bearing. In the later tests we found it best to put the concave side down and thus avoid the trouble.

In test number three we used the same sand and the same treatment, only we used 35 lb. of thermit and 3½ pounds of ¼-in. iron rod, cut into pieces about 8 in. long so that they can be pushed into the thermit for their entire length, previous to igniting the charge. If the bar projects above the surface of the thermit a portion of the metal will not be melted. The amount of iron used in this case was about 10 percent of the thermit used. By using the iron more metal can be obtained from a given weight of thermit charged. Also, as the bars we were experimenting with were of wrought iron, we felt that the use of the wrought iron stock would produce a metal more nearly approaching the wrought iron. This third test was tapped just as the reaction was over. When machining off the collar we found that the metal was not hard, but was exceedingly tough. In machining off the top and one side we found some blow holes, but not to any serious extent. When tested upon supports 20 in. apart it took 50 tons' pressure to break the bar and the fracture was very good, as shown in Fig. 2. The fracture, however, was somewhat more uneven than the one shown in Fig. 1.

After our success with these tests, Mr. Autz decided to try a locomotive frame. The frame first operated upon was broken in the front pedestal over the driving wheels, as shown in Figs. 3 and 4. The break was a vertical one and the frame was of wrought iron, at this point being 3¾ x 5 in. cross section. The machinery taken down included the wheels, driving boxes, shoes, wedges, connecting rods and running board. Five-eighth inch holes were drilled vertically through the break about 1⅛ in. apart, the object being to give the metal a chance to flow up along the line of the crack and result in a solid weld across the entire surface.

The mold was made in a sheet iron flask designed by Mr. Autz, and was a perfect fit in

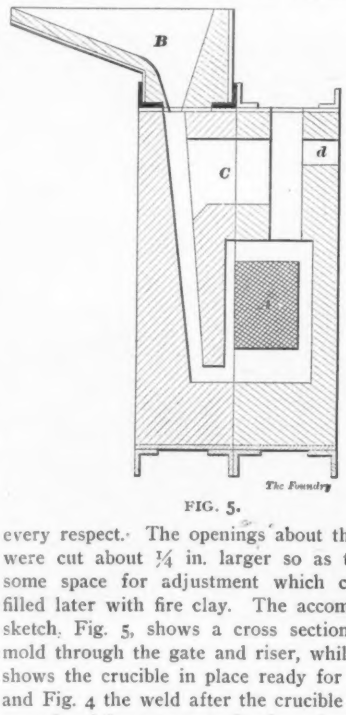


FIG. 5.

every respect. The openings about the frame were cut about ¼ in. larger so as to allow some space for adjustment which could be filled later with fire clay. The accompanying sketch, Fig. 5, shows a cross section of the mold through the gate and riser, while Fig. 3 shows the crucible in place ready for ignition and Fig. 4 the weld after the crucible was removed and the gates cut off. In order to avoid the use of the matches and ignition powders in firing the charge, Mr. Autz conceived the idea of firing the charge by electricity, and the wires connected for doing this are shown in Fig. 3. This method of firing proved to be very successful, and it is certainly more convenient and safer than the lighting of the powder by hand. We used 60 lb. of thermit and 6 lb. of ¼-in. wrought iron rods. The charge was tapped from five to seven seconds after the reaction ceased. Owing to the position of the break it was necessary to build a runner 15 in. long to carry the metal from the crucible to the gate. A special crucible

with one flat side might be made for such jobs as this and would probably be found advantageous.

The weld looked very good from the outside, though there were a few small holes on the top, some of which were 1¼ in. deep. The engine, No. 5024, went into service April 20, hauling heavy freight and fast passenger trains, and up to the present time has given A1 satisfaction.

THE PROSE AND POETRY OF PROGRESS.

BY S. H. STUPAKOFF, PITTSBURG, PA.

Looking backward, with Bellamy, not from the future, but from the present, and that merely over ten or fifteen years, we note what remarkable changes have been made in the foundry, and for that matter in all related engineering and industrial establishments. Before that time, so few were the recorded improvements that in the foundry industry it would seem as if things had been at a standstill indeed. And again, so rapid and radical have been the changes made in recent times toward the betterment of the casting industry that we may be justly proud of the achievements of our earnest workers in contemporary foundry practice.

It is true that some very important innovations were carried out fifty years or more previous to the more recent period of apathy alluded to above. At that already remote time the old furnace was discarded for the cupola, anthracite replaced coal, and again coke replaces anthracite. In this more recent period, however, alluded to as the past present, what have we done. We are accustomed to the stale accusations of the phlegmatic—that we are living too fast. Maybe we are—but did we keep pace with our contemporaries? Some of them have undoubtedly made marvelous strides in allied branches of the industries. But to offset this, we may console ourselves, that a Kepler, Newton, or a Napoleon is not born every day, to continually keep up the turmoil and this little world of ours in an everlasting state of revolution. We may content ourselves in having accomplished our little share, and have certainly passed from dream to reality. We have abandoned the old methods of guess work and stand today on the solid basis of cold facts. Indeed the change from the antiquated to modern foundry practice was no less marked than the epoch which turned Alchemy into the exact science of chemistry.

It seems but yesterday that we judged all pig iron solely by fracture. The grain, lustre, and hue were our only guides we had to select and mix by. It was common practice to keep on hand many brands of iron. Previous experience, "costly experience" were a better term, had taught us that the best and most uniform results were obtained by blending our melt with many kinds of iron made in different furnaces. Today we look at this from a different standpoint. We are skeptical, and appeal to our reasoning powers. We have profited immensely since we have associated ourselves with the metallurgical and mechanical engineer. They have taught us not to rely on fracture, but on composition. Researches in chemistry have directed our attention to the important influence of varying, small quantities of metalloids, which invariably exist in a combined state in our iron ores, as well as in our pig iron and castings. They have also taught us how to determine the quantity of such foreign elements by analysis. Many independent series of physical tests have made us intimately acquainted with the qualities of various mixtures. The result of a combination of both is, that we understand today the direct consequence of certain proportions of foreign admixtures to our iron. We can predetermine to a great extent the qualities of our resulting castings from an intimate knowledge of the analysis of our mixture and from the reactions which are taking place under known heat conditions in furnace or cupola.

We are likewise indebted to the far-reaching researches in Physics, Microscopy, Electro Chemistry and Physical Chemistry for many recorded facts and much valuable information. Their teachings have uncovered many hitherto hidden objects, they have opened new paths and given us an insight into the nature of things, a better understanding of the constitution of matter, and of the specific relationship and properties of the constituents of materials.

But a few years ago very little was known on the melting points, cooling curves, permeability and of the properties of alloys on chilling effects, microscopical structure, hardening, annealing, shrinkage and

strength of iron and steel, whereas, today we are in possession of the most reliable data on these subjects.

As manifold as the achievements were the incentives for research, for the development of old and for the invention of new methods and devices,—our modern stimulants of rapid advancement. Extension of commerce, gigantic new enterprises, increased demand for and increased consumption of articles of commerce and manufacture was the direct cause of spread of our industries. Keen competition, alluring large profits, more exacting requirements, encouraging offers and distributions of scholarships, medals, and well paying, responsible and respected positions, each separately, and all collectively, made us strive irresistibly to the same goal. Truly, it seems as if our sole object in life was only to "Get there."

Liberal exchange of ideas, active communication, interesting discussions and carefully prepared papers on current subjects, executed by the active members of our numerous societies of the engineering professions, of steel makers, foundrymen, metallurgical engineers, electricians, physicists, chemists and experts in other professions have materially added to the general distribution of accumulated practical and theoretical knowledge. The printed proceedings of these societies are our most welcome means of record and reference. Our engineering journals serve for further general distribution, and they make it possible that such permanently recorded knowledge becomes accessible to all. The specialization of our periodicals to subjects within well defined limits has aided greatly in their circulation among our practical workers, where it has borne much fruit and given good satisfaction.

The proverbial "expert operator" who inherited his trade secrets from his father and left them to his own issue is becoming antedeluvian, a subject for ridicule and a thing of the past. To acknowledge that we are running our business with their aid, and under cover of secrets is but an admission of ignorance, and insinuates that our neighbors are incompetent. It is true, there are some more or less intricate processes of manufacture, reaching deep into the domain of organic chemistry, which are not easily fathomed, and which may be kept secret for a long time, but it is altogether different with processes pertaining to inorganic chemistry. Herein we know of no secrets. All roads, however hidden and mysterious to the uninitiated, may be laid open by either analytical or synthetical chemistry.

Thus it is with the iron and steel business of today. Specify your requirements within the limits of possibility, and we are no longer in doubt as to the proper selection of suitable materials, which, treated by fitting metallurgical processes will furnish the desired results. Scientific investigation has opened to our view the book of nature; we have grasped the opportunity to acquire by earnest study a sound knowledge of its fundamental principles and laws, and by deduction and reasoning we have learned and mastered their profitable application to our particular purpose. We have abandoned the old rule of thumb, all haphazard methods and all guess work; we have turned the selection and the preparation of our raw materials over into the hands of specialists, who follow their course on a basis of strictly scientific and therefore unerring principles.

The society for testing materials has gathered together the highest authorities in specific branches of our industries, who have taken upon themselves the arduous task to sift the grain from the chaff. Their endeavor is to lay before our industrial institutions well worked out plans and specifications for guidance in the manufacture of materials for various purposes. Their work is well under way, and they will be our highest court of appeal in all future cases of dispute and difference of opinion.

Summing up, we find that the results of our most recent period are the general distribution of practical knowledge and technical education among our modern engineers and works superintendents. The consequence is a universal acknowledgement of the acquisitions of close observation, sound reasoning, good judgment and calculation. These qualities coupled with energy, foresight and a thorough, broad principled business education give us a fair picture of our successful 20th century manufacturer.

Once more reverting back with our thoughts, we find impressed within our memory that when we started out on our journey of industrial life, our progress was sorely hampered by the wilderness of a

dense forest and jungle. We had to cut our path through its mazes by hard labor, under deprivations and many disappointments. But unflinchingly we kept on to clear away the desperate entanglement of the underbrush, sometimes succeeding in opening a clear spot here and there, which disclosed to our view the clear blue sky. In each instance we were delighted to take a full deep breath in our conquered new realm, into which by our own efforts the broad bright daylight was thrown upon the newly discovered region and its wonders of creation. We report modestly "progress."

And thus we are leaving our estate to our successors. Thanks to the untiring efforts of our contemporaries, and thanks to the interminable will and push of our coworkers we have succeeded in paving the approaches, we have succeeded in obliterating the dense confusion confronting us, and we have succeeded in admitting a few guiding rays of sunshine into former desolate darkness. It remains for our sons and successors to accomplish our arduous task, to follow our footsteps, to continue in our work and to cultivate the rich soil, that they themselves, or perhaps their own sons and successors may reap the full benefit of the seed, so full of promise, so rich in harvest, in contentment and in comfort; which was sown for them by their fathers and forefathers, living in our own inventive and progressive time.

REPORT OF THE COMMITTEE ON STANDARD METHODS OF DETERMINING THE CONSTITUENTS OF CAST IRON.

During the past year your committee has formulated a method for determining the silicon in cast iron, and is now at work on the question of the total carbon. The following is the method which your committee recommends to be the Standard of the Association, for the Determination of Silicon in Pig Iron and Cast Iron:

"Weigh one gramme of sample, add 30 c. c. Nitric Acid, (1.13 sp. gr.); then 5 c. c. Sulphuric Acid (conc.). Evaporate on hot plate until all fumes are driven off. Take up in water and boil until all ferrous sulphate is dissolved. Filter on an ashless filter, with or without suction pump, using a cone. Wash once with hot water, once with Hydrochloric Acid, and three or four times with hot water. Ignite, weigh, and evaporate with a few drops of Sulphuric Acid and 4 or 5 c. c. of Hydrofluric Acid. Ignite slowly and weigh. Multiply the difference in weight by .4702."

In recommending the above method, it was recognized that it is almost an impossibility to get chemists to use a standard method in their daily work. Hence the above method, as recommended, is intended primarily as a check method in case of dispute between different laboratories, or as between buyer and seller.

Hence a method, accurate in every point was sought, shortness being sacrificed to some extent to insure accuracy or the chance of error by a careless operator. Little in the above is left to the judgment of the chemist.

It will be further recognized that in the purchase and sale of pig iron or castings under specification, that standard methods are essential in order to allow the parties of both parts make their determinations with the assurance that, on the score of method, they are on the same footing.

Respectfully submitted,
H. E. Diller, Secretary,
Metallurgical Section, American Foundrymen's Association.

A MODERN METHOD OF VENTING CORES.

BY JAS. A. MURPHY, FRANKLIN, PA.

The proper venting of cores has always been a theme upon which foundrymen could base interesting argument. Bad venting has always furnished a ready made excuse for a bad casting by the molder; indeed, when he could think of nothing else to lay the blame on, the core was sure to come in for a bad character and the coremakers' ability was criss-crossed with suitable and expressive adjectives.

Not all molders recognize the degree of skill that is required to vent some crooked cores properly, nor do all coremakers realize how necessary it is to have vents through which the gas will flow easily and without any unnecessary obstruction.

The evolution of the air compressor, gas engine and automobile has set the brightest minds in the business experimenting, seeking a remedy for the poorly vented cores that cause such disturbances at casting time. The proper vent-

ing of this class of cores is a far more skillful operation than most people are ready to allow, and it is only seldom that the coremaker has the proper facilities to do the job properly. The core shop is the most neglected part of our foundries today and it is only within a few years that it has been given any notice at all. It is a hopeful sign of the times, however, to see foremen and employers in general waking up to its necessities and its possibilities.

The pulling of wires and soaped strings around corners as a means of venting is a thing of the past. The wax wire method of

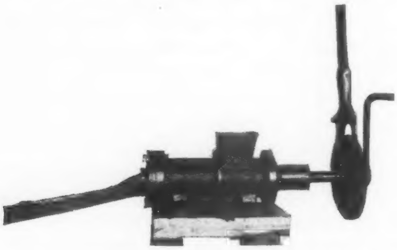


FIG. 1. PRESS WITH WAX WIRES BEING FORCED OUT.

venting has come into our foundries to stay. All methods of wax wire venting are not by any means satisfactory.

The wax taper with a string or threads running through it gives very poor satisfaction, that with the wire through it is better but its cost is an item of no small consideration and many foundries prefer to do without it and continue to lose castings on this account. The object of using the wax, of course, is that the core while drying absorbs the wax, leaving only the string or wire which when pulled out leaves an open and free hole.

If the string gets burned on the end it is a difficult job to pull it and if it breaks inside the core it cannot be extracted. An imperfect vent is the result and a possible blown casting.

The wax wires, Fig. 1, are the result of much experiment to do away with strings of any kind in the wax, in fact, to have something that was as nearly fool-proof as possible.

The element of cost was also a consideration and the composition used is made at less than one-eighth of the cost of any wax on the market today. The illustration of the machine, Fig. 1, gives a fair idea of the process of manufacture. A helper will turn out enough of different sizes to last 30 coremakers one day in about one hour, so the cost of manufacture is infinitesimal, once the installation is made.

These wires are easy to handle, are not sticky except when hot, are as tough as twine when at the right temperature, and can be made in coils of any length or cut off in desirable lengths and laid away in trays ready for instant use. There is no waste as the pieces not used, short ends, etc., are again put back in the machine and pressed out as new wires.

The thickness is regulated by the die. In practice I make them from 3-32 to ⅜ in., but any desired size can be made. The material is very light and I have known men not to use a pound all day venting the most complicated of jacket cores for air cylinders.

The skill of the coremaker is considerably minimized in producing a perfectly vented core, as it is impossible for him to do otherwise if he rams up a string of this wax in the proper parts of the core. It is not claimed that this wax will take the place of rods, but its absorption by the sand in baking has a very decided tendency to strengthen the core.

Several cores that must be made in halves in order to be properly vented can be made in one

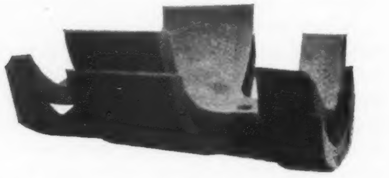


FIG. 2. JACKET CORES VENTED WITH WAX WIRES.

piece by this process at a considerable saving of time and expense.

Since I designed this machine and brought this method of venting cores to what I consider a state of absolute perfection, in the shops of the Chicago Pneumatic Tool Co., at Franklin, Pa., blown cores are a thing unknown in our foundry where every casting is filled with them and where work of the most intricate character is the rule rather than the exception.

I cannot lay too much stress on the time saving qualities of this machine. Venting is at best a tedious and time-killing operation no matter how it is done, but with this wax all that is necessary is to ram up the string in the proper place and the job is done permanently and well.

The ingenuity of the most expert designer in producing crooked orifices for which cores must be employed in the production of the casting, is defied, for as long as there is left

any opening through which a small pipe can be passed a perfectly vented core can be made by this process.

Several foundrymen who have seen the process in operation have pronounced it one of the most important of inventions for the cheap and safe production of intricate work.

Its cost of installation being very small, the cost of the material not worth mentioning, no waste material, the accessibility of all sizes of strings in any quantity at a moment's notice and the perfection of the cores that it is used in, are all points very much in its favor of being later as universally adopted as the core making machine.

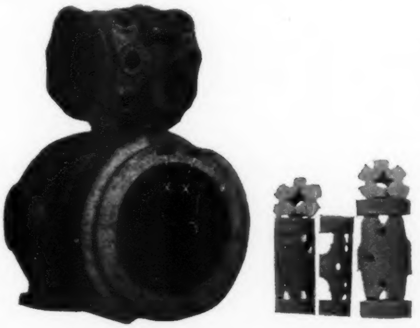


FIG. 3. CYLINDERS AND CORES.

NOTE—The protograph reduces the cores more than the cylinder. The vent is all taken off trough x x.

I consider it an absolute indispensability in shops which make a specialty of pump, engine, air compressor, gas engine, automobile or other intricate or delicate work. In several of these shops its savings in the course of a year would run well into the thousands of dollars.

COST KEEPING FOR THE FOUNDRY.

BY R. W. MCDOWELL, UNIONTOWN, PA.

In presenting a paper of this kind, it would be useless to describe a system of cost finding for any special line of foundry business, as such a paper would be of interest to only those whose foundries are devoted to that particular class of work. Therefore it will be attempted to outline a system of a general nature only, showing the main features of foundry cost accounting in as a plain and simple a manner as possible. The subject of foundry cost keeping has become of far greater interest to foundrymen than it formerly was, owing partly to the vast improvements that have been made in foundry methods and appliances, making it necessary to keep the methods in the office up to the standard of those in the foundry, but due to a greater extent to the keen competition of recent years which has made it necessary for the foundryman to know just what his product is costing, and how to reduce this cost if possible. And the only way that he can obtain this information is through an accurate and reliable system of cost records, the rough estimates that served the purpose in former years being practically worthless.

A cost keeping system for a foundry is neither as difficult to handle nor as complicated as might be imagined. Like the cost accounting for any other line of manufacturing business, it is based on four main elements of expense, namely: Material, labor, factory expense, including such items as lubricating oil, maintenance of machinery, flasks, etc., and general expense, including taxes, insurance,

Form 3

DAILY MATERIAL REPORT

Date__________ No.______

Kind of Material	Quantity	Check
No. lbs. Molding Sand		
No. lbs. Core Sand		
No. lbs. Facing		
No. lbs. Flour		
No. lbs. Chaplets		
No. lbs. Fire Clay		
No. Gals. Linseed Oil		
No. Gals. Core Compound		
No. Gals. Molasses		
No. Quarts Carbon Oil		
Sundries		

__________ Foreman

The Foundry

etc. The system should be gotten up with a view to obtaining these items with accuracy and with little trouble.

The cost system should be arranged to run in harmony with the general accounting system, being in fact a part of it. Special columns should be provided in the books of original entry to take care of the various items mentioned above, from which they may be obtained for the cost sheet. It is better to figure costs by the month, and not to attempt daily costs as it is manifestly impossible to obtain the various items of expense, outside of material and labor, daily. These may, however, be obtained monthly direct from the general account books.

In operating a cost system, one can do no

DAILY CUPOLA REPORT.

Date Feb. 15. 1904 No. 38

Kind of Iron	Pile No.	No. lbs.	Per C.	Ck.
Pig. No. 1	24	10980	17	
Pig. No. 2	31	21110	32½	
Pig. No.				
New Scrap Grade a	7	18191	28	
New Scrap Grade				
Machine Scrap	11	4215	06½	
Shop Scrap		819	01¼	
Bad Castings, Heat of 2/13/05		2060	03½	
		57378	88½	
Remelt, Heat of		7622	11½	
Total Iron to Cupola		65000	100	

Coke 8130

Flux 560

Blast on 12:50 Off 4:50 Time of Heat 4 hours

No. lbs. iron melted per 100 lbs. coke 799

Good Castings	51680	Total Iron Melted	65000
Bad Castings	1947	Deduct Result of Heat	61739
Remelt	8112	Melting Loss	3261
Total	61739	Per cent	.05

Remarks:

Form 1

The Foundry

better than to follow the rule given below, which appeared in an article on manufacturing accounts by Kenneth Falconer. It is as follows:

"The keystone of factory accounting is a rigid adherence to the rule that no work shall be put in hand, expenditure incurred, or goods or material delivered, without written authority emanating from the office, and that all papers and records referring to or reporting such work must bear the number of the order authorizing the same." This may be adapted to any line of cost accounting.

MATERIAL.

Iron being the most important item of the material used, the reporting of it will first be considered. Each day's heat is reported on a blank similar to form 1. This report may, if so desired, be arranged to show the amount of each charge by arranging a column for each kind of iron and leaving a line for each charge. These reports should be made up with care and measures should be taken to see that they are accurate at all times. A monthly report, Form 2, is made up from the daily reports, showing the total quantity of iron used during the month, together with the cost. Coke and flux are also included in this report.

Sand and similar materials are reported daily on a slip like Form 3. A method of

Form 2

IRON REPORT FOR MONTH OF________________190____

Kind and Grade of Iron	Weight	Total	Perct.	Price	Amount
Pig No. 1	274560		16½		
Pig No. 2	532180		31¾		
Pig No.					
Scrap, Grade a	319468		19¼		
Scrap, Grade B.	163194		09¾		
Machine Scrap	112139		07		
Total New Iron		1401541	83¾		
Shop Scrap	19663		01¼		
Bad Castings	52894	72557	03½		
Total		1474098	87½		
Add Remelt		196842	12½		
Total Iron to Cupola		1670940	100		
Cost of Iron					
Coke	208870				
Flux	11910				
Total					
Good Castings	1258960				
Bad Castings Deduct	51614				
Remelt	197346				
Whole Results	1507920	1507920			
Loss		163020	.09¾		
Net Cost of Iron					
Cost of Coke, Flux, etc.					
Whole Cost					

The Foundry

checking these slips should be provided so as to insure accuracy. Molding and core sand should be brought in on trucks of large capacity, each truck load being weighed as it passes over the scales. Other materials which are of convenient bulk for keeping in the store room are obtained by means of requisitions. The ideal method of keeping track of material would be to keep it all in the store room and let nothing go out without a requisition having been made out for it, but in the case of iron, coke, sand, etc., this would be impossible, so that the only method to pursue is to correctly report them.

Stock records should be kept, and whenever any material runs low an inventory of it should be taken and the stock record checked with it. Besides proving the records, this saves a great deal of time at the close of the year, as it will not be necessary to take a full inventory of all materials. A convenient form of stock record is shown in Form 4.

Form 4

RECORD OF MATERIAL **No.**

Name of Material Where kept.

Received				Used				Balance	
Date	Order	Amount	Total	Date	Order or Req.	Amount	Total	Date	Amount

The Foundry

Form 6

PRODUCTION SHEET FOR ______ 190 ___

Names	Nos.	Name of Casting	Pattern	Order	No. Up	Bad	Good	Wt. Up	Wt. Bad	Wt. Good	Ck.	Pct.	Classification			

The Foundry

Form 7

PAY-ROLL FOR HALF MONTH ENDING ______ 190 ___

Department ______

	Names of Employes	Nos.	Wed. 1	Thu. 2	Fri. 3	Sat. 4	Sun. 5	Mon. 6	Tues. 7	Wed. 8	Thu. 9	Fri. 10	Sat. 11	Sun. 12	Mon. 13	Tues. 14	Wed. 15			Hours	Pcs.	Rate	Day Work	Pc. Work	Pro.	Non Pro.	Total	Deduct.	Amount Due.

The Foundry

Form 8

PURCHASES FOR MONTH OF ______ 190 ______

	Supplies	Iron	Equipment	Labor	General Expense	Patterns	Factory Accounts			General	Fol.	Names	Fol.	Accounts Payable
							Expense	Repair	General					

The Foundry

Form 5

ORDER NO. ____________________

DATE ____________________

EMPLOYEE NO. ____________________

ARTICLE ____________________

____

OPERATION ____________________

DATE		IN	OUT	IN	OUT	TOTAL
1-16						
2-17						
3-18						
4-19						
5-20						
6-21						
7-22						
8-23						
9-24						
10-25						
11-26						
12-27						
13-28						
14-29						
15-30						
31						

San Francisco Office.

TOTAL HOURS __________ MIN. __________

RATE ____________________

AMOUNT ____________________

The Foundry

LABOR.

The next expense item is the labor. There are a number of methods of keeping track of the labor in a foundry, all of which have their own advantages, and it depends largely on what proportion of the labor is paid for by the day, and what by the piece, as to what method should be employed. But in the opinion of the writer, the best method is found in the use of one of the modern time recorders. The time of each man is thus kept on a card similar to Form 5 for any desired period. The illustration shows a card gotten up for bi-monthly pays. The time of molders working on piece work is taken from the production sheet, Form 6. The exact arrangement of this sheet will depend largely on the classification of the product, but the form shown gives a good idea of about what will be required: It may be made up from cards turned in by the molders, or a report may be made up daily by the timekeeper or factory clerk, going from floor to floor and taking down the name, number, pattern and number up, of each molder. This is entered on the production sheet, and the sheet made up in as many copies as required. It is completed when the weighmaster's copy comes in to the office giving the result of the heat.

The time book or pay roll is shown in Form 7. This is arranged in very much the usual manner, with the exception of the provision which is made for separating productive and non-productive labor, for convenience in figuring costs. When the plant is arranged by departments, one or more pages of this book may be allowed for each department.

FACTORY AND GENERAL EXPENSE.

Special columns for recording factory and general expense should be run in the journal, cash book, and purchase book or voucher record, of the regular account books. In this way all expenses incurred during the month are classified in the regular books and are in the most convenient form for posting to either the main ledgers or the cost sheet, and it is thus assured that no expense items will be omitted in making up the cost sheet. A shop order is issued monthly for keeping track of all repairs, all material and labor used for this purpose being charged up against this order. A page of the purchase book is shown in Form 8, showing the arrangement of the special columns. In case of the plant being divided into departments, columns are allowed for each department, also.

THE COST SHEET.

The cost sheet is shown in Form 9. Material, other than iron is obtained from the "used" division of the stock records and figured at cost value. The cost of iron is transferred from the monthly iron report. Productive and non-productive labor are then obtained from the pay roll, and then come factory expense, general expense, fuel and light and sundry expense, taken from the special

Form 9

Cost Sheet for month of ________________ 190____

Expense Items	Cost	Extension	Total	Last Mo.	Differ.
Iron					
Coke					
Flux					
Molding Sand					
Core Sand					
Linseed Oil					
Other Material					
Sundries					
Total Material					
Productive Labor					
Non-productive Labor					
Repairs					
Factory Expense					
General Expense					
Fuel and Light					
Foremans Wages					
Net Cost Production					
Patterns					
Office Expense					
Freight					
Special					
Total Cost of operating					
Good Castings					
Machine Work					
Sundry Jobs					
Total					
Deduct Cost					
Profit					

The Foundry

columns in the regular books, and repairs as shown by the shop order. The total of these items gives the net cost of production. To this total is added freight, office expense, patterns and special expense, giving the whole cost of operating for the month. It is customary with some foundries to charge up the expense of producing patterns against the cost of the regular product, but the belief of the writer is that they should be treated in the same manner as machinery or any other equipment for the reason that they are not an actual factor in the cost of getting out the product any more than the cupola is. One would hardly charge up the cost of the cupola against the cost of the first month's production, and it is scarcely more reasonable to charge up expensive patterns against the cost of production of the month in which they were made, when these same patterns will be used for many other months to come, in a great many cases, and if such items are included, a false cost per lb. of the finished product is the result. Therefore a distinction should be made between the cost of production and the cost of operating for a given time, and patterns should be included in the latter division, but not in the first.

If so desired, the sheet may be arranged according to departments, and this arrangement is desirable in a large plant, but it is not so shown in the illustration, as this is intended to illustrate a general system.

The forms shown here are intended to represent and illustrate the simplest possible forms and methods of foundry cost accounting. and would, of course, have to be modified considerably for the requirements of any

special line of foundry work. In this form, however, they are more easily adapted to the needs of anyone wishing to design and operate a cost system on these lines, and it is hoped that the system as a whole or in part may be of some benefit to those desiring to install such a system.

MAKING A MOLDER.

BY H. M. LANE, CLEVELAND, O.

The molders of the past have been produced, first, by serving an apprenticeship, and second, by adding to the knowledge thus gained by traveling about and working in different shops. In the days when all foundries carried on a general line of work and but little machinery was used in the foundry, this procedure would produce an all-around molder.

In most cases these old-time molders were very good judges of the various local irons, and many of them would make creditable mixtures by judging the fracture. In the present day, however, a great many new factors have been introduced into the problem. In the first place the iron now furnished the foundryman varies between much wider limits and may contain greater quantities of impurities than that formerly furnished.

In the molding work itself two factors have entered the foundry trade which tend to produce specialists rather than all-round molders.

First, the various foundries have been led to specialize to the greatest possible extent. One of the first specialties to break away from the general foundry business was stove plate trade, and this has now become so thoroughly separated that it is recognized as a distinct branch of the trade, and stove plate experience would be of but little use to a man if he were placed in a general jobbing foundry doing light or medium weight work. Many other specialties have split off from the foundry business, such as cast iron pipe, soil pipe, ingot molds, radiators, bath tubs, and other sanitary plumbing fixtures, etc. In addition to this, the malleable industry has become so specialized that the molders belonging to this division of the craft do not generally pass back and forth between malleable and gray iron foundries.

Second, many factors have been introduced into the shops themselves, the principal among these being the molding machine. The result of all this is that the high-grade molder for light floor work does not find the demand for his services which formerly existed; at least in proportion to the tonnage for this class of work that is turned out. The heavy workmen have suffered less from the changes that have taken place, on account of the fact that the methods of producing castings in this department have not undergone such radical changes. An all-round molder, however, should have experience in both light and heavy work.

The rapid fluctuations in the amount of work of each character being done in the foundry have also had a serious effect on the apprenticeship question. While the shop may have work enough at one time to warrant their employing a considerable number of apprentices, within a year of that time the character of the work upon which they can use apprentices may have all gone to the other fellow.

Apprentices have also been affected by the "Big wages quick" mania. As a consequence, after the boy has spent about half of his time in one shop, he is very likely to bolt and go into another shop where he gets journeyman's wages, or, if he is taken under instruction, gets much higher wages than he received in the first shop. When the wages go up the amount of work he turns out must also go up, and hence he is kept as largely as possible on one class of work. The result is that he becomes a poor workman with a limited amount of experience.

One foundryman stated recently that while he employed over one hundred molders in his place, his work was so highly specialized that he could not conscientiously take on a single apprentice, as he knew he could not teach them the trade, no matter how much he might desire to do so.

Skilled molders will always be required for some classes of work and we must provide some means for keeping up the supply of this class of men. Another factor, and one which is in some ways more important is the question of our future foundry foremen. As the work in the different foundries is more highly specialized, and as the number of difficult problems in the line of equipment increases from year to year, it results in an ever-increasing demand on the ability of the foundry foreman. The trade

of molding could not be learned from a book, but more book knowledge is required now than formerly. The problem of where our future foundry foremen are coming from affects other departments of the shop as well as the foundry, and hence some of our brightest men have been discussing the subject and proposing different plans for its solution.

What seems to the writer one of the most feasible plans is to install a plant for the manufacture of quite a broad line of machinery. The plant should be large enough to employ about one thousand hands in all departments. It might manufacture the following line of machine tools: lathes, planers, milling machines, drill presses, and grinding stands. It should also manufacture a line of gas engines and of steam engines. It might also be well to manufacture some sheet metal working machinery and some wood-working machinery.

This would give a broad range, including a large amount of foundry and blacksmith shop work. The line of machinery could be disposed of to advantage by selling the entire outfit to some large jobbing house like Manning, Maxwell & Moore. In the foundry it would also be well to make some specialties requiring no machine finish, as for instance, track plates, stove legs, or something of the kind which could be gotten out largely on molding machines.

Connected with the establishment there would be a corps of teachers; and a regular course would require four years, distributed somewhat as follows: The student upon entering would spend nine months in a series of shop work which would correspond very closely to the shop work given in a manual training school. This would include some wood work, some patternmaking, a little experience on light work in the foundry, a few weeks in the blacksmith shop, and some time in the machine shop. This work would be accompanied by an elementary course of lectures upon these subjects or by studying in textbooks along these lines.

When a boy enrolled he would be expected to pay down one hundred dollars. During the first nine months he would receive no pay; and if at the end of this period he decided he did not want to learn the trade, he would be allowed to go and be given back one-half of the money he had paid in. If at this time he did elect to learn a trade, he would have to choose which trade he wished to follow. If he wished to follow the foundry trade he would first be put onto a molding machine and taught how to make a large number of different classes of molds in this way. This work would include instruction in the theory of molding machine construction and manipulation.

From the molding machine he would pass to the core department. In this department he would receive instruction in the making of cores by hand, and with the use of various types of machines. He would also receive instruction upon the value of the different core compounds or binders.

From the core department the boy would go to the light work floor, where he would spend some time, and then to the heavy work floor, where he would receive instruction both in green sand and dry sand work, also in loam work. This general course would occupy approximately two years and three months. The boy would then select his specialty and spend the last year on it.

Some instruction would be given in mixing iron by analysis, etc., and if a boy wished to become a foundry chemist there would be a post graduate course for this purpose, extending through the fifth year. After the first nine months the boy would receive pay for his work at a certain fixed rate. Careful account would be kept of what he did, and if he exceeded a certain amount of work, he would be given a bonus above the fixed rate of pay, but all of this bonus would be kept back until he was through with his course. When he finished his course he would receive a certificate or diploma, would be paid back the original one hundred dollars which he deposited, with four percent interest, and would also be paid all accumulated bonuses, which in some cases might amount to several hundred dollars. The accumulation of this big bonus, together with the fact that if he left any time after the probationary nine months' period he would lose both the bonus and the hundred dollars, would serve as an incentive to keep the boy at work to the end of his course. In starting such a school it would be necessary to employ journeymen enough

to run the entire factory, and it would always be necessary to employ some journeymen to act as lead workmen and instructors, but after the third year it should not be necessary to employ more than ten percent of journeymen, as by this time the boys would become pretty expert mechanics.

The education necessary for entering such a school would be simply a good common school education. The studies given during the course would be the equivalent of a high school education, or at least of the portion of it required by workmen of this class. Such an institution as this should be self-supporting after the first year or so, as while the boys would undoubtedly spoil a large amount of material, this would be in large measure offset by the fact that the boys would work for work's sake, in other words, would not soldier. While such a plant as this would not have any dividends to pay, it would nevertheless have to support the teaching force, which would probably be equivalent to a fair dividend on the capital invested.

The boys would probably work on an eight-hour basis, but would have recitations taking all or a portion of some of the half days, for instance, one class would have their recitations on Monday, Tuesday, and Friday mornings, another on Tuesday, Thursday, and Saturday mornings. In like manner the others would have afternoons of the alternate days. The plant would run six days a week throughout the year, with the exception of the ten days or two weeks' shut-down at the holidays, and the granting of such holidays as Decoration Day, Labor Day, Independence Day, and Thanksgiving.

Such a school as this would make an excellent preparatory school for our technical schools and colleges, and while the graduate from this trade school would go to a technical school conditioned in foreign languages, he would receive credit for shop work which would more than balance his deficiencies in languages. For boys who wished to become foremen and managers, a fifth or post-graduate year could be arranged in which a course would be given on shop management, shop systems, etc. The students in this fifth year would be given positions as foremen or assistant foremen in different dpartments in the works.

One very important feature in this system would be the necessity of preparing a special course of text-books to fill the exact requirements of the case, and upon the preparation of such a series of books the success of the school would in large measure depend.

The ideal location for such a school is a subject which should receive considerable attention. If placed in a large city it would be possible to arrange visits to other works; the libraries of the city would be available to the students and there might be some support from other works. If located in a small town 25 or 30 miles from a large city, the high city taxes would be avoided, there would be less going on at night to take the boys' attention from study, and it is probable that the works could be built on a somewhat more extensive plan, with more yard room, dumping ground, etc., which is a point worthy of consideration.

FAN BLOWER VS. POSITIVE PRESSURE BLOWER.

BY H. F. FIELD, PITTSBURG, PA.

This paper is based upon a report presented before the Pittsburg Foundrymen's Association on December 5th, 1904.

To those not familiar with the details a brief sketch of the circumstances which led up to the report should prove interesting.

On March 7th, 1904, Mr. Thos. D. West read a paper before the Pittsburg Foundrymen's Association entitled, "Fan Power for the Cupola." This paper dealt with the cost of operating the Fan Blower for cupola work. Mr. West showed that the amount of horse power consumed was much greater than generally anticipated by the makers. The discussion on this paper led to a comparison between the fan and positive pressure blower for the cupola. The relative amount of horse power required was the original point at issue. The subject presented such an important field for investigation that a special committee of the Pittsburg Foundrymen's Association was appointed to consider the subject. The committee at first hoped to solve the problem by obtaining data from different foundries. A great deal of valuable information was received in response to circulars sent out. These results, however, were quite contradictory and were obtained under such different conditions that it was impossible to make from them anything like a comparison between the two types of blowers.

Mr. W. H. McFadden, a member of the committee decided that a test should be made under as nearly the same conditions as possible. He made arrangements to have these tests made at the works of MacIntosh, Hemphill & Co., of Pittsburg. Four tests were made and the results of these tests were communicated to the Pittsburg Foundrymen's Association in the form of a report. This report was printed in many of the trade papers and created considerable discussion. It was due to the interest thus manifested that your Secretary asked to have the subject presented to this Association at this time.

The data presented in the Pittsburg report was as complete as possible and the same tables and illustrations will be used as a basis for this paper.

TESTS OF FAN AND POSITIVE BLOWER MADE AT MACINTOSH, HEMPHILL & CO.

Apparatus—

- No. 10 Sturtevant Fan Blower, furnished by B. F. Sturtevant, Hyde Park, Mass.
- 33 cu. ft. Positive Pressure Blower, furnished by the Connersville Blower Co., Connersville, Ind.
- No. 8 Sturtevant Fan, property of MacIntosh, Hemphill & Co. 50 H. P. 220 Volt Westinghouse Motor, with a rated speed of 125 revolutions per minute.
- 30 H. P. 220 Volt Westinghouse Motor, 1100 revolutions per m.

Those officially connected with the test were engineers representing Sturtevant Company, Connersville Blower Co., Westinghouse Electric & Manufacturing Co., and MacIntosh, Hemphill & Co. An expert was also present to take temperature readings for the first two tests.

Arrangement and Construction—

The Connersville Blower was placed on a solid cement foundation. The No. 10 Fan Blower was placed on an oak platform directly over the blower.

The No. 8 Fan was on the floor overhead and necessarily had one extra bend in the pipe connecting it with the wind box.

This arrangement, together with the position of belts, etc., is shown in accompanying sketch.

The piping and wind box were new and installed especially for the tests in order to reduce leakage to a minimum.

Necessary bends in the pipes were made on very easy lines.

All arrangements were submitted to the Fan & Positive Pressure Blower makers and were reported by them to be satisfactory.

The cupola was lined to 54 inches. The position of the same is readily discernible in the sketch. The size of blowers, speeds of motors and blowers, and sizes of pulleys were regulated by the Fan and Blower makers.

FIRST TEST NO. 10 STURTEVANT FAN BLOWER

(OCT. 17, 1904).

(Based on tests made at Ft. Pitt Foundry by W. H. McFadden, vice president and general manager of MacIntosh, Hemphill & Co.)

TABLE NO. 1. FIRST HEAT, OCT. 17.

No. 10 Sturtevant Fan Blower.

Time.	Pressure.	No. Volts.	No. Amp.	E. H. P.	H. P.	Motor Speed.	Temp.
2:02	12½	212	145	41.2	36	840	
2:10	12½	208	155	43.2	38.5	844	
2:20	12⅞	215	148	42.6	38	840	
2:30	12⅞	216	144	41.7	37	845	
2:40	13¼	216	132	38.2	33.5	850	
2:50	13½	220	128	37.7	32.5	840	
3:00	13⅛	218	130	38	33	840	
3:10	13	218	128	37.4	32.5	825	
3:20	13¼	218	120	35.1	30.5	840	
3:30	13½	220	126	37.2	32.5	845	2185° (ladle)
3:40	13¾	216	125	36.2	31.5	830	
3:50	13¾	220	115	33.9	30	845	
4:00	14	217	123	35.8	31	847	
4:10	14	217	112	32.6	28	845	
4:20	14	219	112	32.9	28.5	837	
4:30	14⅛	217	110	32.0	27.5	840	
4:40	13¾	217	105	30.5	25	833	2150° (ladle)
4:50	13¾	214	105	30.1	25	832	
5:00	13¾	214	110	31.5	26	830	
5:10	13⅞	218	110	32.1	27.5	838	
5:20	14	219	110	32.3	28	838	
5:30	14	220	115	33.9	30	840	
5:40	13¾	220	120	35.4	31	840	
5:50	13¾	219	130	38.2	33.5	837	
Average	13.6			35.8	31.2	839	

This table gives the time the readings were taken, the pressure in ounces at the cupola, the current and voltage readings, the E. H. P. figured from the latter, the H. P. figured from the motor curve, and the motor speed.

There are several important facts to be learned from table No. 1. First, that the pressure remained practically constant throughout the heat. Second, that with a constant voltage the amperage decreased as the heat progressed. The result of this is shown in the E. H. P. column. The H. P. consumed constantly decreased as the heat progressed until toward the very end, when it increased again slightly. This latter increase was coincident with the lowering of the metal in the cupola at the end of the heat, thus reducing

the pressure in the cupola. This decrease and then increase in the H. P. is due to the fact that as the heat progressed the tuyere-openings became clogged up. This offers a resistance to the free passage of the air from the fan blower. A proportionately less amount of air is supplied and consequently a less amount of H. P. is required to furnish this air. The increase in H. P. toward the end of the heat is due to a reduction of the pressure when the iron becomes low in the cupola, and gives a freer passage for the air. With a fan blower the H. P. thus becomes a guide to the amount of air supplied to the cupola. It is, in fact, the only guide which is at all reliable. The pressure gauge is of value only for comparisons, and then only when the readings are taken at the same time in the heat and under the same conditions.

TABLE NO. 2. FAN BLOWER HEAT, OCT. 17, 1904.

	Time.	Time taken.	Amount melted.
Wind on	2:02		
First tap	2:23	23 min.	
First ladle out	3:38	1 hr. 36 min.	27,630
Second ladle out	4:39	1 hr. 1 min.	14,750
Third ladle out	5:10	31 min.	6,000
Fourth ladle out (bottom drop)	5:48	38 min.	7,800
Amount taken out in shanks			700
Amount left in cupola			800
Total amount melted iron			57,680

Table No. 2 gives a record of the heat, showing the time the wind went on, the time ladles were taken out, etc. From this data we note that the heat lasted three hours and forty-six minutes; that the rate of melting decreased as the heat progressed, due to the fact that the tuyeres became partly closed towards the end of the heat. Table No. 3 gives the average amount melted per hour, and rate of melting at different times in the heat.

TABLE NO. 3. FAN BLOWER HEAT, OCT. 17, 1904.

Total time of heat	3 hr. 46 min.
Average amount melted per hr. based on iron charged	16,116 lb. (8.06T)
Average amount melted per hr. based on iron melted	15,312 lb. (7.65T)
Rate of melting, first of heat, based on iron melted	17,262 lb. (8.63T)
Rate of melting, middle of heat, based on iron melted	15,000 lb. (7.5 T)
Rate of melting, end of heat, based on iron melted	12,230 lb. (6.12T)

TABLE NO. 4. FAN BLOWER HEAT, OCT. 17, 1904.

Total length of heat	3 hr. 46 min. (3.78 hr.)
Average horsepower consumed by motor	35.8
Total e. h. p. hours for heat	134.8
Number of tons charged	30.35
Number e. h. p. hours per ton charged	4.41
Number k. w. hours per ton charged	3.29
Number tons melted	28.84
Number e. h. p. hours per ton melted iron	4.67
Number k. w. hours per ton melted iron	3.41

Table No. 4 gives a record of average H. P. consumed by the motor, together with the H. P. per ton charged. Knowing the cost of an electric H. P. the founder can readily figure the cost of the power for melting his iron.

SECOND TEST, 33 CU. FT. CONNERSVILLE BLOWER (OCT. 19, 1904).

The conditions for this test were as nearly as possible like those for the first test. The difference in piping is readily discernible in the sketch.

Table No. 5 gives a record of this heat.

In studying this table we note first that the pressure increased as the heat progressed until towards the end of the heat it decreased again.

With a constant voltage the amperage increased steadily until toward the end of the heat. This increase in H. P. as the heat progresses is characteristic of this type of blower. As the openings in the tuyeres became partly closed the positive pressure blower must supply the same amount of air through the decreased opening. This must be done at an increased pressure which would consequently require a greater H. P. The drop at the end of the heat is due to the lowering of the pressure, as the amount of iron in the cupola decreases.

TABLE NO. 6. CONNERSVILLE POS. PRESS. BLOWER HEAT, OCT. 19, 1904.

	Time.	Time taken.	Amount melted.
Wind on	2:00		
First ladle out	3:33	1 hr. 33 min.	31,800
Second ladle out	4:05	32 min.	12,100
Third ladle out	4:28	23 min.	6,620
Fourth ladle out (bottom drop)	4:49	26 min.	6,950
Taken out in shanks, left in cupola, etc.			2,207
Total amount melted iron			59,677

TABLE NO. 7. POS. PRESS. BLOWER HEAT, OCT. 19, 1904.

Total time of heat	2 hr. 49 min.
Average amount melted per hr. based on iron charged	22,368 lb. (11.2T)
Average amount melted per hr. based on iron melted	21,186 lb. (10.6T)
Rate of melting, first part of heat, based on iron melted	20,520 lb. (10.2T)
Rate of melting, middle of heat, based on iron melted	21,400 lb. (10.7T)
Rate of melting, last of heat, based on iron melted	17,718 lb. (8.9T)

TABLE NO. 8. POS. PRESS. BLOWER HEAT, OCT. 19, 1904.

Average e. h. p. supplied to motor	40.6
Total e. h. p. hours for heat	114.49
Number of tons charged	31.5
E. h. p. hours per ton charged	3.63
K. w. hours per ton charged	2.71
Number tons melted iron	29.8
E. h. p. hours per ton melted iron	3.84
K. w. hours per ton melted iron	2.86

Tables Nos. 6, 7 and 8 give the data for this heat that tables Nos. 2, 3 and 4 did for heat No. 1.

COMPARISON OF HEATS NO. 1 AND NO. 2.

Let us compare the H. P. readings in table No. 1 and No. 5. In the former we find that the maximum H. P. was registered at the beginning of the heat. In the second case more H. P. was consumed at the end of the heat. With the fan blower the H. P. consumed started at 38½ and decreased to 25, and then

TABLE NO. 5. TEST HEAT, OCT. 19.
33 cu. ft. Connersville Positive Pressure Blower.

Time.	Pressure.	No. Volts.	No. Amp.	E. H. P.	H. P.	Speed.	Temp.
2:00	10½	224	80	24.0	19	825	
2:10	14¾	217	110	32.0	28	830	
2:20	14	218	108	31.4	26	830	
2:30	16½	218	118	34.5	30	835	
2:40	18½	218	130	38.0	32.5	835	
2:50	21¾	216	150	43.4	39	830	
3:00	23¼	214	152	43.6	39	810	
3:10	23	215	152	43.8	39	810	
3:20	23½	212	152	43.2	38	810	
3:30	23½	214	155	44.4	40	812	2165° (ladle) 1st
3:40	25	212	156	44.3	40	815	
3:50	24	216	160	46.3	41	815	
4:00	24	214	165	47.3	42.5	820	
4:10	25	210	177	49.8	45	815	2175° (ladle) 2d
4:20	24½	212	170	48.3	43.5	816	
4:30	20¼	214	145	41.6	36.5	830	
4:40	19¾	214	140	40.2	35	830	
4:50	19¼	215	123	35.4	30.5	780	
Average	20⅝			40.6	35.8	819	

increased again to 33½. With the positive pressure blower the opposite occurred, the H. P. started at 19, increased to 45, then decreased to 30½. The difference in construction between the fan blower and positive pressure blower can be illustrated in no clearer manner. Within reasonable limits the amount of air delivered by the fan is dependent upon the size of the opening; the larger the opening the more air will be delivered by the fan, and consequently the more H. P. will be required to drive the fan.

With the positive pressure blower the amount of air delivered is not dependent upon the size of the opening; every revolution of the blower is certain to deliver just so much air. The H. P. consumed, however, is directly dependent upon the opening. The smaller the opening the greater will be the H. P. required.

In table No. 9 I have condensed the record of two heats for comparison.

From this table it will be noted that the average E. H. P. consumed during the fan blower test was 35.8, against 40.6 E. H. P. for the positive pressure blower. The length of time, however, was so much in favor of the blower that the total number of H. P. hours consumed by the fan was 134.8 for 30.35 tons, against 114.49 H. P. hours for 31.5 tons. This would give an average of 4.41 H. P. hours for the fan blower, and 3.63 H. P. hours for the positive pressure blower for each ton of iron charged. The saving in time in favor of the blower should prove quite an item in shops where the iron can be taken away as fast as it is melted. This would allow the delaying of the blast for 1 hour in a 30 ton heat, thus giving an extended molding time of 1 hour. Some shops are equipped with cupolas which when melting to their fullest capacity melt more iron than can be taken care of. In such instances this saving would not apply.

The original cost of installation considerably favors the fan. The wear and tear on the blowers seem to be an open question. The fan blower maker claims a saving in re-

TABLE NO. 9.

Date.	Oct. 17.	Oct. 19.	Oct. 22.	Nov. 16.
Blower.	No.10. Sturtevant.	33 cu. ft. Connersville.	33 cu. ft. Connersville.	No. 8. Sturtevant.
Tons charged	30.35	31.5	32.	31.
Tons melted	28.84	29.8	30.08	28.81
Tons iron charged per hr.	8.06	11.2	10.9	10.07
Tons iron melted per hr.	7.65	10.6	10.2	9.40
Number of hours run	3.77	2.82	2.93	3.08
Average e. h. p. (motor)	35.8	40.6	36.3	34.6
Average h. p. (from curve)	31.2	35.8	31.55	
H. p. h. per ton charged	4.41	3.63	3.32	3.43
K. w. h. per ton charged	3.29	2.71	2.47	2.68
H. p. h. per ton melted	4.67	3.84	3.53	3.70
K. w. h. per ton melted	3.41	2.867	2.63	2.76
Av. speed of motor in r. p. m.	839	819	756	1102
Av. speed of blower in r. p. m.	1557	171	151	2204
Average pressure in ounces	13.6	20.6	20.75	12.5
Ratio of coke to iron	1—7.82	1—7.78	1—7.9	1—8.

pairs and wear over the positive pressure blower, while the makers of the latter contend that the wear and slippage of belts, due to the high speed at which the fan blower is run more than counterbalances.

The positive pressure blower was much more severe on the lining than was the fan. This would be expected from the higher pressure shown in the second test.

SUPPLEMENTARY TESTS.

I was convinced by the preceding test that a greater H. P. economy could be shown by the positive pressure blower when running at a slower speed. To prove this a third test was run on Oct. 22nd, the results of which are found in the following tables:

This test showed a decided decrease in the H. P. consumed. The total time occupied by the heat was, however, somewhat longer. The H. P. consumed increased and decreased in the same manner as in test No. 2, in fact, the results were very similar to the previous test of this blower, except that there was a decrease in the total H. P. and a slight decrease in the wear on the lining. This test brought out the fact that too much air can be forced into the cupola to obtain economical results. This is due to a decrease in

TABLE NO. 10. TEST HEAT, OCT. 22.
33 cu. ft. Connersville Positive Pressure Blower.

Time.	Pressure.	No. Volts.	No. Amp.	E. H. P.	H. P.	Speed.	Temp.
12:15	11	225	80	24.1	20	760	.....
12:25	11¾	225	92	27.7	23.5	770	.....
12:35	12½	225	76	22.9	17.5	770	.....
12:45	15	225	90	27.1	23	765	.....
12:55	16¾	220	100	29.5	25	765	.....
1:05	19½	220	110	32.4	28	750	.....
1:15	22¼	210	125	35.2	30	745	.....
1:25	22¾	225	130	39.2	35	750	.....
1:35	25¼	218	145	42.4	37.5	750	.....
1:45	24¾	210	145	40.8	35.5	750	.....
1:55	25	214	140	40.2	35	750	.....
2:05	25	218	145	42.4	37.5	750	.....
2:15	25½	216	150	43.4	38.5	760	.....
2:25	26	210	155	43.6	38.5	760	.....
2:35	26	216	155	44.9	40	770	.....
2:45	26	216	155	44.9	40	760	.....
2:55	21¼	220	130	38.3	34	770	.....
3:05	20½	220	125	36.8	32	780	.....
3:15	18¾	220	113	33.3	29	780	.....
Average	20¾	218	124	36.3	31.55	756	.....

the melting area, owing to a greater chilling of the iron around the tuyeres. We should have liked to have continued this experiment by still further decreasing the speed of the blower. This would, however, have necessitated the installation of a new motor. The room used for this test was needed in our regular work, so that further testing had to be abandoned.

TEST NO. 4—NO. 8 STURTEVANT FAN BLOWER (NOV. 16, 1904).

In order to find out how our own equipment of a No. 8 Sturtevant Fan, driven by a 30 H. P. motor would compare with the blowers used in the previous tests, a fourth test was run on Nov. 16th. Unfortunately for exact comparisons, the scrap we were using at this time contained a certain amount of lighter scrap than that used in a previous test. In other respects the conditions were identical. This test is not included for comparative purposes, but rather to show what can be done by changes in the charging of the cupola. The following illustration should impress upon all users of the fan type of blower the necessity of charging their cupola in such a manner as to give a free passage for the air. The fact that light scrap melts easier than heavy scrap

TABLE NO. 11. CONNERSVILLE POS. PRESS. BLOWER HEAT, OCT. 22, 1904.

Wind on	12:14	
First tap	12:38	
All melted (2 hr. 56 min.)	3:10	59,160
Left in cupola		990
Total amount melted		60,150
Rate of melting per hour (iron charged)		21,816 (10.9 tons)
Rate of melting per hour (iron melted)		20,502 (10.2 tons)
Total e. h. p. hours		106.36
E. h. p. hours per ton iron charged		3.32
K. w. hours per ton iron charged		2.47
E. h. p. hours per ton iron melted		3.53
K. w. hours per ton iron melted		2.63

could not possibly account for the difference in the rate of melting between test No. 1 and test No. 3. This difference in the rate of melting was due to the fact that this light scrap was in such shape that it kept the cupola open and gave a freer passage for the air. If you will examine the results of this test as shown in tables 12, 13, 14 and 15, you will at once be struck with the uniformity in rate of melting, in E. H. P. consumed, etc.

In comparing test No. 1 with test No. 4 you will note that there was a decrease of 13.1 E. H. P. when the No. 10 fan blower was used, as against 7 E. H. P. when the No. 8 fan was used. You will also notice that the decrease in the rate of melting follows this decrease in E. H. P. very closely. In test No. 1, table No. 2, which gives the record of melting for the No. 10 fan we find that the first ladle was taken out in 96 minutes, and shows an average of 8.55 tons of melted iron per hour. The average E. H. P. for the same time was 38.4. The slowest rate of melting during this heat showed an average of 5.8 tons per hour, while the average E. H. P. consumed at this time was but 31. In test No. 4, table No. 3, the No. 8 fan melted between 2.30 and 3 o'clock at the rate of 10.6 tons per hour. The average E. H. P. at this time was 37. The slowest melting during this heat showed over 9 tons per hour with an average E. H. P. of about 32. These facts show distinctly that when a fan blower is used there will be a uniform rate of melting as long as the cupola can be kept open. If the rate of melting decreases, as the heat progresses a record of the H. P. consumed during the heat would show whether this was due to a decrease in the amount of air supplied by the fan blower.

CONCLUSIONS DRAWN FROM TESTS.

The following facts must be borne in mind in comparing the fan blower with the positive pressure blower. A fan will deliver a maximum amount of air only as long as there is a free opening, and when this opening is made smaller the fan will deliver less air. As the opening grows smaller, and consequently the amount of air delivered grows less, there will be a corresponding less amount of H. P. required to run the fan. The H. P. consumed then in driving a fan is in a measure proportionate to the amount of air delivered by the fan. The action of a positive pressure blower

TABLE NO. 12. TEST HEAT, NOV. 16. DATA—NO. 8 STURTEVANT FAN BLOWER.

Time.	Pressure.	No. Volts.	No. Amp.	E. H. P.	Speed.	Temp.
1:45	11	218	115	33.6	1100	.....
1:55	10⅞	214	128	36.7	1100	.....
2:05	11¾	220	130	38.3	1100	.....
2:15	12½	220	130	38.3	1100	.....
2:25	12⅞	220	126	37.2	1100	.....
2:35	12⅞	220	125	38.8	1100	.....
2:45	17⅜	220	125	36.8	1100	.....
2:55	12⅜	218	120	35.1	1100	.....
3:05	12¾	220	115	33.9	1100	.....
3:15	13⅛	220	115	33.9	1120	.....
3:25	12¾	220	115	33.9	1100	.....
3:35	12½	220	112	33	1100	.....
3:45	13¼	218	110	32.4	1100	.....
3:55	13½	218	110	32.1	1120	.....
4:05	13¼	218	110	32.1	1100	.....
4:15	13⅛	216	110	31.5	1100	.....
4:25	12½	216	115	33.3	1100	.....
4:35	12¾	220	115	33.9	1100	.....
4:45	11⅞	...	...	....	....	.....
Average	12½			34.6	1102	

is exactly opposite. The construction of this type of blower insists upon a given amount of air being delivered per revolution. The larger the opening the less H. P. will be required to deliver a given amount of air through that opening.

It is necessary to have the piping connected with a fan blower as short and free from curves as possible. When curves are necessary they should be built on easy lines and not in sharp curves. This feature is not as important to the economical action as a positive pressure blower. Too little attention is paid to these details in considering the utility of a fan or positive pressure blower for cupola work. I have seen cupola piping through which a fan could not economically force air to melt iron. When the fan was replaced by a positive pressure blower a great improvement was noticed. The same results might have been accomplished by increasing the size of the pipe and removing several bends.

TABLE NO. 13. NO. 8 STURTEVANT FAN BLOWER HEAT, NOV. 16, 1904.

Wind on	1:43	
First ladle out	2:30	12,360
Second ladle out	3:00	10,600
Third ladle out	3:22	7,150
Fourth ladle out	3:47	7,720
Fifth ladle out	4:26	11,850
Sixth ladle out	4:48	6,790
Taken out in shanks and left in cupola.		1,160
Total amount melted		57,630 (28.81 tons)

TABLE NO. 14. NO. 8 STURTEVANT FAN BLOWER HEAT.

Average amount melted per hr. based on iron charged	10.07 tons
Average amount melted per hr. based on iron melted	9.41 tons
Rate of melting, first of heat, based on iron melted	9.1 tons hr.
Rate of melting, middle of heat, based on iron melted	9.5 tons hr.
Rate of melting, last of heat, based on iron melted	9.4 tons hr.

TABLE NO. 15. NO. 8 STURTEVANT FAN BLOWER HEAT, NOV. 16, 1904.

Average horsepower consumed by motor	34.6
Total e. h. p. hours for heat	106.56
H. p. hours per ton charged	3.43
K. w. hours per ton charged	2.68
H. p. hours per ton melted	3.70
K. w. hours per ton melted	2.76

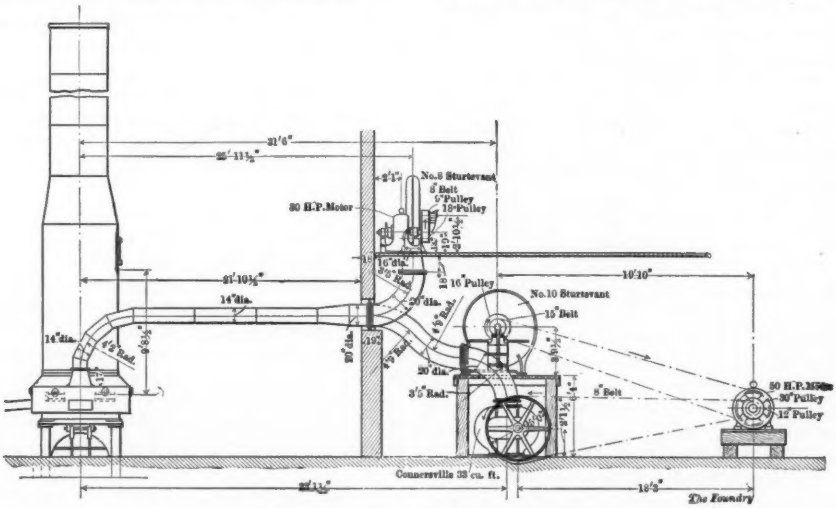
In the almost endless discussion pro and con which has arisen over this subject, very little consideration has been given to the different conditions under which the fan and positive pressure blower work. The nature of a cupola renders it impossible to obtain anything like a theoretical efficiency when a fan or blower is used. When the fan or positive pressure blower are of correct size to economically melt iron in a given size cupola, there will be comparatively little difference in their efficiency at the beginning of a heat. It is probable that under these conditions the fan is the more economical on account of its low cost. As the tuyeres begin to close up the fan fails to deliver as much air per minute through the reduced area. At the same time the H. P. consumed and the amount of iron melted per hour become less. When the positive pressure blower is used and the tuyeres close up the same amount of air is forced through at a higher pressure, and the H. P. required to drive the air through the decreased opening is increased. There is an inconsistency in the construction of the positive pressure blower which should be mentioned in this connection. There is an air outlet or escape valve which regulates the pressure. No mention was made of this under the tests, as this valve was fastened down tight. When this valve or outlet is used it is regulated by weights. When the pressure gets above a certain point the valve opens and allows the excess of air to escape. This valve causes the positive pressure blower to lose its positive type as far as the cupola is concerned, and thus the principal advantage of the positive blower over the fan blower. It might be mentioned in passing that a test was run using this escape valve. The results were not as satisfactory as when the valve was kept closed. When the cupola becomes closed up toward the end of the heat the blower instead of forcing air through the cupola at a higher pressure will raise this valve, allowing a certain part of the air to escape. The H. P. used in furnishing this escaped air is thus a dead loss.

Another feature to be considered is the material charged into the cupola. Shops using

stove plate and other light scrap will find that this material will tend to keep the cupola open and promote a more uniform rate of melting.

Let me again impress upon you the fact that in studying these tests all the circumstances must be considered. Do not compare your own isolated experiences made under entirely different circumstances with these tests. I have already placed a great deal of stress upon the size and shape of scrap used and the method of charging the cupola. We have repeatedly obtained much better results than shown in the table. In fact this always occurs when our scrap runs at all light. On the other hand I received recently a letter from a foundryman who has the same size cupola, the same number and make of fan, who states that he obtains but 5 tons per hour as against 10 tons shown in the fourth test. This distinctly shows that the size of the cupola and the size of the fan are not the only factors which control the rate of melting. Poor cupolas and poor cupola practice cannot be counterbalanced by any form of blower, however perfect.

This paper would not be complete without a mention of the valuable paper contributed at the last meeting of this Association by Mr. W. H. Carrier. The formulae given by him at that time are quite generally borne out by the results obtained in these tests. In a more recent paper, however, delivered before the Buffalo Foundrymen's Association Mr. Carrier makes a statement which is not wholly in accord with the results which we obtained in the MacIntosh-Hemphill tests. He states that under practical working conditions the operation of the fan usually proves superior owing to the great flexibility of the blast. Our tests showed that the fan blower worked to advantage only when the amount of air was constant. The results were poorest in the test where the "flexibility" was shown by a decrease in H. P. toward the end of the heat. The contention that the blast may be regulated to a better advantage in the case of the fan by the use of a blast gate is a valid one. Every positive pressure blower should be arranged so that its speed may be regulated. There is no economy in driving a blower from a shaft with other machinery. It should have a separate motor or engine with means supplied to regulate the speed of the same. This would counterbalance any advantage which the blast gate would give to the fan blower.



ARRANGEMENT OF FANS AND BLOWER.

The criticisms which appeared in the trade papers concerning the original report should receive a word in closing. The Sturtevant Company, who furnished the fan blower, in criticising the test, said: "A single piece of scrap might in any one of the four individual tests have been of such excessive size as to introduce abnormal resistance to the passage of air and gases upward through the charges." It was plainly stated in the report

concerning the tests that the scrap was of a uniform size in the first three tests, so that this possibility could not exist. This criticism implies that the Sturtevant Company appreciate the greatest weakness in the fan blower type, viz., that when the free passage of air is at all obstructed, the fan blower does not deliver the same amount of air. Their contention that a series of tests should be run through an extended period and under varying conditions is not warranted. In order to get anything like a comparison the conditions surrounding the tests must be identical. It is much more difficult to produce the same conditions over an extended time than it is for two tests immediately following one another. The liability of the materials and machines varying makes this suggestion of the Sturtevant people impracticable.

Their third and final criticism reads, "The report as published lacks much desirable data regarding the cupola, blower and fans and general arrangement." This is a very indefinite criticism, but it is only fair to say in behalf of the report that the data was all submitted to and approved by the Sturtevant people before it was published.

The Buffalo Forge Company in commenting upon the report call attention to the excessive size of the fan used. This matter was left wholly in the hands of the fan makers. We did call their attention, however, to the discrepancy between the size used in the test and the size recommended in their catalogue for the size of cupola in which the test was made.

The Roots Blower Company in discussing the test consider that the positive pressure blower was run at too high a speed, or rather that the pressure produced at the cupola was excessive for economical results. In reply to this I would say that the speed at which the blower was finally run was much less than originally recommended by the makers. A preliminary heat was attempted at that speed with very disastrous results to the lining. This was called to the attention of the engineer of the positive blower makers and the speed was lowered for the tests. In connection with the contention of the Roots Company that better results would have been obtained had the escape valve been used, I would repeat what has already been stated in the paper, viz., that this was tried and that the results were not up to those shown in test No. 3.

In conclusion let me state that the object of these tests was not to decide or recommend any type or make of blower. They were made to obtain information in regard to the relative efficiency of the two types of blowers. This, I consider, has been accomplished. In the tables and diagrams which are included in this paper as well as in the original report I have endeavored to place this material in such a form as to be of future use to founders in selecting fans and blowers for cupola work.

A PRACTICAL FOUNDRY SCHOOL.

BY W. C. BRUCE, CLEVELAND, O.

There has been considerable discussion of late upon the question of where we are going to obtain our supply of competent mechanics in all branches of trade, but more particularly and the one that concerns us most is, where are we going to get our molders and coremakers? At the present time, with the limitations placed upon apprentices by the different unions, the supply is not equal to the demand.

There has been quite a number of other learned papers written on this subject, one by Mr. Higgins, before The American Society of Mechanical Engineers, and one by Professor Sweet, of Syracuse, New York, before the Engineers' Club, of Syracuse, and others. Professor Sweet in his paper remarked that it was propable that a practical school of this kind could never be formed until there was a good shop for sale, and some one philanthropic enough to buy and keep it for the purpose.

There are quite a number of technical schools in the country, but I have never yet seen a practical mechanic turned out of that kind of an institution.

A foundry school must have a general line of castings to make, so that when the apprentice is turned out, he will have a general knowledge of the business and be able to command wages as a practical molder or core maker.

In an ordinary apprenticeship, as it is now carried on, there is no one to give the boy any special instructions, and if he makes a mechanic at all, it is because of his superior natural qualifications along that line.

There is no question in my mind but that we could get plenty of young men who would be very glad of an opportunity to learn a business or trade that pays as good wages as the average molder can make, provided he did

not have to serve an unreasonable time to do so.

I believe that one year's experience in the proper school with the proper instructions would be equal to the present four years' course in the average foundry, and, in fact, six weeks for an ordinary intelligent man should be sufficient for him to learn to turn out good work on 75% of the work that is made in the ordinary foundry.

Now the writer has a proposition to make, that should it meet with your favor, will make the establishment of a practical foundry school an assured fact. I have a foundry building practically new that has a capacity for 30 to 40 tons per day, with two cupolas, electric equipment and everything complete ready to start business. This plant cost fifty thousand dollars ($50,000.00) and is complete in all its details, is located in a town of five thousand (5,000) inhabitants, in Ohio, and it can be secured practically as a gift. The purpose is to incorporate for one hundred thousand dollars ($100,000.00). Fifty thousand dollars ($50,000.00) in stock of this to go to pay for the plant and fifty thousand dollars ($50,000.00) for the working capital, to be divided up in one hundred dollar ($100.00) shares. This fifty thousand dollars ($50,000.00) would be sufficient to place the plant on a practical paying basis, and every stockholder would have the right to send as many boys to this school as he might see fit up to the capacity of the plant and in regular rotation. They would also have the right to have these apprentices educated on their patterns.

The writer will agree to market and take care of the output of the castings of this plant without in any way entering into competition with the stockholders who may be operating jobbing foundries.

Should any one prefer to make a donation towards this purpose instead of a stock subscription, they would be allowed the same privilege as a stockholder as far as sending apprentices to the school is concerned.

Should this proposition meet with your approval, I may say I have the stock subscription to which I have quite a number of shares already subscribed. Stock to be paid for, 25% cash and balance in 60 and 90 days.

Meeting of the American Foundrymen's Association in New York, June 6, 7 and 8.

The American Foundrymen's Association, with its affiliated branches, held its annual meeting in New York, June 6, 7 and 8, with headquarters at the Murray Hill Hotel. Most of the sessions were held in the Grand Central Palace, Lexington avenue and 43d street, though the morning and afternoon sessions on Thursday were held at Columbia University.

OPENING SESSION OF THE A. F. A.

The tenth annual meeting of the American Foundrymen's Association convened at the Grand Central Palace on Tuesday morning, June 6. The association not being the guest of either the city or the local foundrymen, the usual opening formalities were dispensed with. President Chris J. Wolff called the meeting to order promptly at ten o'clock

President's Address.

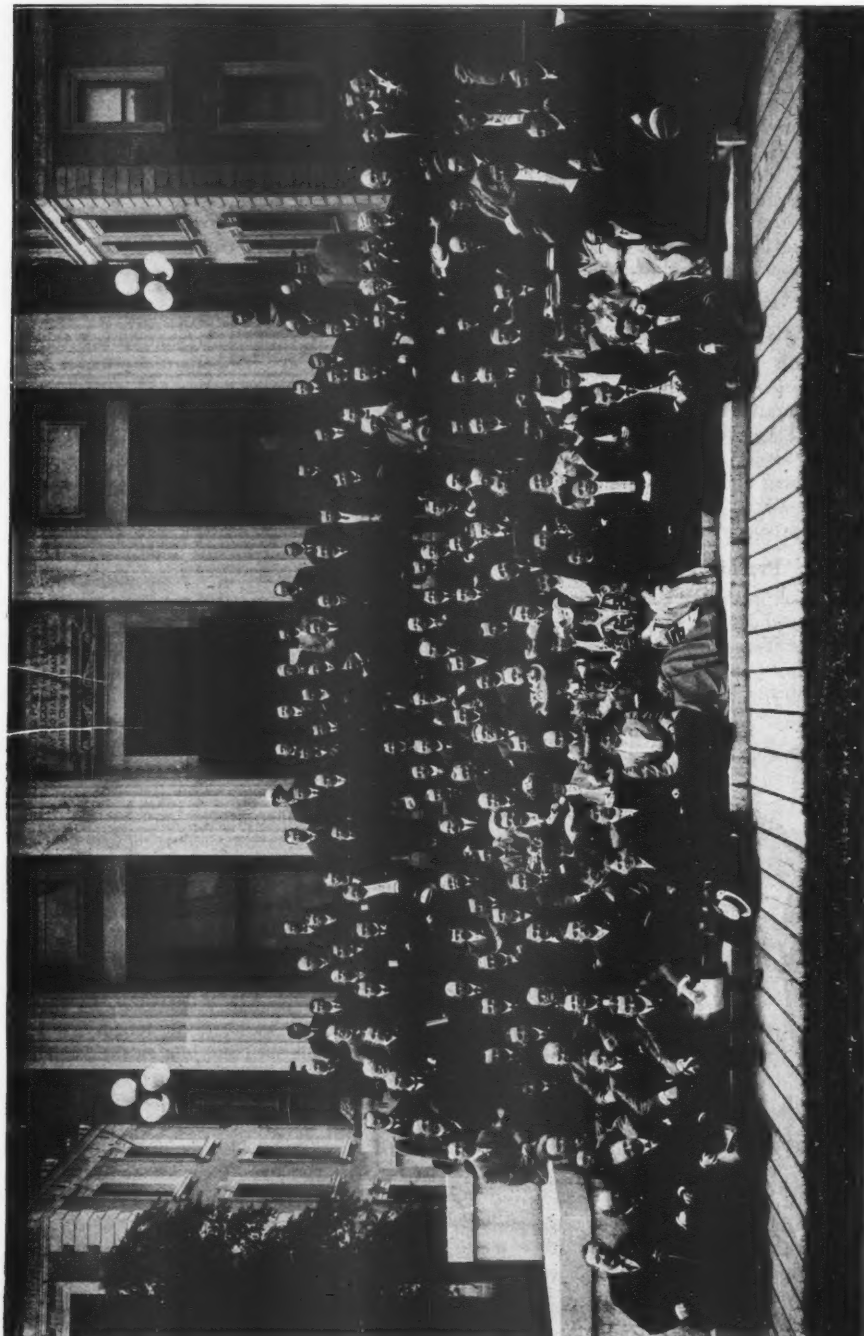
"The most instructive and pleasurable of our public assemblies are those which engage all of our members in the association's common good. This being our tenth annual convention, we justly look back with pride on the vast strides that have been made in an educational way by our organization since its inception in Philadelphia in 1896. Among the advantages of this association to its members, and by no means the least, is the formation of agreeable acquaintance.

CHRIS J. WOLFF.

True, we have not obtained the highest desire of some, but no candid estimate of us by the outside world has fallen below excellent.

Our aim has always been to help educate the world as far as we can in our chosen field. The good work of this organization has not all been accomplished without criticism, for associations, like men, should not expect praise without envy until they are dead. The present time is one characterized by organization for mutual support in whatever direction this may tend. Only that organization which gives more than it receives will survive and really be useful to the State. In the foundry industry only those organizations which are founded on the wide open door principle, for interchange of thought and experience, will serve the country best. Our own association invites three factors in the trade—the owner, the superintendent or foreman, and the molder, patternmaker or other workman—into full membership, giving them all equal rights and the opportunity to get acquainted, to exchange views and experiences in the carrying out of every part of the foundry program. For that reason we invited the foundry foreman's organization to become part of us, and welcomed them as such, after we had satisfied ourselves that they were an educational institution only and had no ulterior motive antagonistic to this fundamental idea of ours. The results have been most gratifying It would be advisable for our association to let the foundry owners know by circular letter or otherwise of the foremen's association and have them encourage their foremen to join it. Every foundry owner who has taken the trouble to get where he can learn something relative to advanced ideas in foundry practice has added to the value of his plant as a producer. Every foreman who has opened his mind to what other people have found to be good becomes a better employe and loses the predilections tying him to the narrow views of the foundry floor. Every molder who wishes to learn the details of all parts of the foundry business puts himself in line for speedy promotion. We therefore invite every one connected with the foundry to join our organization and help to build it up on these lines. Especially we invite the foundry owner to get out of his shell and join on the common ground with his employes, where he can learn again what he has often forgotten since he himself graduated from the floor. He will find himself repaid by an increase of loyalty on the part of his employes through the feeling of mutual sympathy and interest engendered by the principles of our association.

"In my anxiety to respond promptly and fully to the confidence which you placed in me I urged such measures as the objects of the association provided for or conditions justified, and have ever stood ready to execute the



GROUP OF A. F. A. AND A. F. F. MEMBERS AND FRIENDS TAKEN AT COLUMBIA UNIVERSITY, JUNE 7, 1905.

will of the majority. It will be observed that, though the president is held responsible for every policy and act of the association, yet his authority is absolutely dependent on the support of the officers and committees. Differences of opinion or even disagreements on methods should not always be regarded as opposed to the association's interests, and in this spirit I most heartily appreciate the co-operation and assistance afforded me. My sincere thanks are hereby due and tendered to each of the officers and members for the earnest devotion with which you have supported my efforts."

Secretary's Report.

A very active year of Association work is now behind us. The foundry industry is truly waking up, and he who doubts it, may simply glance at the programme of the present meeting to satisfy himself that this is so. Nevertheless, this does not mean that we have received the support from the industry that is due our work and ideals. The disturbances of the foundry world have been frequent and severe. The changes in organization of the individual plants have been many. New blood is coming in everywhere, and with it a closer understanding of expense and income, good and bad methods of work, and a restlessness on the part of the buying public, which requires the closest study on the part of the gray iron founder, to overcome.

Our steel casting and malleable plants are full of orders today, but the same cannot be said of the iron foundries. Hence attention is given in a greater measure than ever to improving the quality of the foundry output, and hence science is playing a greater part in our work than we might suppose.

THE SECRETARY READS HIS REPORT.

Many of us will recall the discussion on the purchase of pig iron we had while in Buffalo. It was just the year of the turning from fracture buying to chemical analysis. Today what founder does not scrutinize the analysis cards of his shipments to satisfy himself that all is well, even if he holds to the old way of doing business.

The trade school question is coming up stronger and more persistent all the time, and well can we wish it success and that it may come quickly. The Government itself is waking up to one of its functions, and the Bureau of Standards promises to become a most important aid in helping to eliminate the uncertainties besetting details of manufacture, where all are concerned equally. Even today the question of standards, such as we have been preparing for the chemist and foundryman, is being studied by this splendid undertaking of the Government; and we wish it all success.

In view of the meagre support given our efforts to get out fuller transactions, the Journal of the Association had to be abandoned, and occasional issues of papers and discussions substituted therefor. No one regrets this more than your secretary, though the burden the Journal entailed on all that contributed so ably to its literary and technical success, was a heavy one.

Through the generous arrangement with the *Foundry*, whereby our papers are printed at cost, and can thus be distributed cheaply to the membership, we have succeeded in removing the debt of the Association, and the financial statement is now as follows:

Income from dues, sales, interest, and standardizing bureau		$2,208 85
Expenditures:—		
Debt of last year	$ 995 04	
Printing	52 20	
Postage	217 00	
Transactions	135 15	
Expense	5 00	
Secretary's office	400 00	
Standardizing bureau	337 52	
Total		$2,141 91

leaving a balance of $66.94 to our credit.

An analysis of the expense will show a few things of interest to us. First of all the cost of the transactions has been very low. This unfortunately also means that our members get much less than formerly, and hence the annual dues of the Association should be materially decreased. The experiment of giving a better Journal having failed through lack of support, and the fact that trade journals are giving much better material now than heretofore, precludes any attempt, or should do so, to go back to the old method again. There are today more journals devoting space to foundry matters than formerly, and they have the advan-

tage of advertising matter to offset the printing costs, which is something we as an association should not go into. I would therefore strongly urge a reduction of the annual dues to even as low as $3.00, thus giving our present members a better equivalent, and also tending to increase our membership.

From the item of postage, it will be seen that with very little expense for the transactions, the correspondence has increased enormously. Your secretary's office easily reflects the waking-up process above referred to. If all the foundrymen who have requested advice, or wanted information could have been induced to become members, we would have a better showing in that respect than is the

MOREHOUSE AND FIELD TALK OVER THE FAN QUESTION.

case. It seems, however, that the idea of supporting an association which works hard for just such betterment of the industry, is considered secondary to the immediate gain derived by asking, and taking the chances of getting the information or advice for nothing. Such, however, is life, and only the ideals we subscribe to, of bettering the industry at the expense of our time and energy, whoever may profit thereby, hold us above discouragement and giving up the work in despair.

The bright side of the problem lies in the universal recognition of the work of the Association. England and Germany have organized similar associations, freely following our lines of endeavor.

Our membership today is 294, or 16 more than last year, which in spite of the drain on the resources of foundrymen demanded by other movements, speaks well for our loyalty to the cause. Even India is represented in our membership list. The Association, however, should be much greater numerically, for there are nearly 5,000 foundries to draw from, and surely most of them can stand a little more knowledge generously distributed about the place.

You will receive separate reports from the Foremen's and the Metallurgical Sections. These movements are now rapidly approaching a stage when they can act independently of us and we are proud to have assisted in interesting these branches of the industry in studying their field closely and finding betterment and success therein.

I would therefore recommend the continuance of the work as heretofore, by committees, the printing of the transactions under the favorable arrangement with the *Foundry,* the reduction of the dues, and a continued effort on the part of our members to assist the secretary in increasing the interest and support of the industry in our chosen work.

Respectfully submitted,
RICHARD MOLDENKE, Secretary.

Pattern Insurance.

It will be remembered that the committee on pattern insurance reported a blank form for taking care of patterns last year and outlined a general scheme for pattern insurance. The report of the committee this year was read by Dr. Moldenke, in the absence of the chairman, Frederick Conlin, of Bethelehem, Pa. In the course of his remarks he said the insurance interests of the country have an agreement by which is case of fire they never pay more than ten per cent of the value for the loss of patterns, which is often an injustice to the foundryman, because frequently the patterns are worth more than the foundry itself. He recommended that all members of the association press the insurance interests harder to get this injustice corrected, and suggested that a system be substituted whereby losses would be paid on a depreciation of 5 per cent per annum for metal patterns, and 10 per cent for wooden patterns, the date of the last use of the pattern to be that from which the depreciation is dated. An illustration in point was made of the system in vogue on railroads for insuring rolling stock,

PULLEY JONES

in which the value of the car is depreciated each year it is in service.

The report of the committee on coke tests was also made by the secretary. H. E. Field, of Mackintosh, Hemphill & Co., Pittsburg, drew up the plan of operation and Dr. Moldenke carried on the tests. A series of cokes which were made at the exposition were used to melt iron under standard and identical conditions in the cupola of the model foundry at the World's Fair. The results of the 19 tests made will be published by the Government later. The secretary added that the lesson to be learned was that if every foundryman watched closely the method of charging and adapting the cupola to the particular quality of coke used they might get much better results than they do, and it would be no longer necessary to swear by Connellsville coke as the only thing to use. For instance, a very light coke which was tried burnt out so quickly in the bed that the iron being brought in contact with the blast burned away over 60 percent. On the other hand, a very heavy coke took so long to burn that very unsatisfactory results were obtained.

L. G. BLUNT.

The committee on sand beds for molds reported progress and was continued.

Report of Committee on Foundry Trade Schools.

The chairman of the committee on trade schools was absent, but the report was presented by W. H. MacFadden, of Pittsburg. The report dealt wholly with the Carnegie Technical School, and was as follows:

The Carnegie Technical Schools expect to have ready for operation this fall a portion of its buildings. Among the first buildings to be erected will be that one which contains the foundry. This foundry will be equipped with the best modern appliances, and supervised by an instructor of experience in both the practical and theoretical side of foundry practice, aided by such assistants as he may need.

Two courses will be established; a day course for the students in Applied Science, who wish to ultimately specialize in one of the engineering branches, or in foundry practice. Their instruction will be thorough, on the theory and practice of molding, construction of the cupola and furnaces, the technology of the fuels, the metallurgical chemistry underlying the mixes, construction of the flasks, the making of cores, and such familiarity with foundry equipment in general as will enable them to see the underlying principles on which they operate.

In addition to the above technical instruction, general instruction will be given in physics, chemistry, mechanical drawing, English, mathematics, costs and business organization. A limited number only can be admitted this year for this course of instruction.

The applicants for admission will be tested by entrance examinations.

The evening course in this foundry covers, in the same number of lesson hours and therefore a greater number of years, practically the same ground that is covered in the technical branches, but merely deals with the general branches in an elementary form. This night course for instruction in molding and foundry practice is projected primarily for the benefit of those already engaged in that occupation. Preference will be given to those who are employed in foundries in the daytime.

"YOU SEE IT'S JUST THIS WAY."

The course will be not less than three years in length for night students, and it is hoped that the employing founders will insist upon their apprentices and helpers attending with regularity.

Admission for special instruction in this night course is also conferred upon any journeyman molder already employed in a foundry, or out of employment who desires the theoretical instruction and understanding of the fundamental principles which are necessary for him to advance himself, as a more skillful molder or to raise himself to the position of foreman of molders. This night course of instruction will be thorough and consist largely of laboratory constructions, directly attached to the foundry, or in the foundry itself.

DAVID SPENCE.

In no instance will emphasis be laid upon the student applicant to pass a difficult entrance examination as it is the opinion of the school authorities that the employers have already examined and qualified to the fitness of the applicant, since said student is already in the employ of said manufacturer.

A series of general lectures on sand, on iron, graphite, silica and on basic open-hearth steel, brass, copper, and other castings will form a part of the instruction, and these lectures all who are interested can attend.

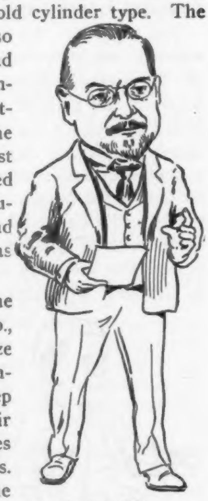
Blowers, Piping and Cupolas at the Plant of the Michigan Stove Co.

After all the business had been transacted on Tuesday morning, Mr. W. J. Keep, of Detroit, Mich., read his paper on "Blowers, Piping and Cupolas at the Plant of the Michigan Stove Co." This paper provoked considerable discussion.

W. J. KEEP ANSWERS A FEW INQUIRIES.

L. G. Blunt, of the Westinghouse Electric & Mfg. Co., Pittsburg, asked if Mr. Keep had noticed the oxidation of silicon and carbon in the cupola at the melting ratio he mentioned, and whether he had kept any record of the losses. Also if he found by varying the amount of fuel and blast whether a cheaper grade of pig iron could be used. Mr. Keep replied that they had made some very accurate tests on a week's work on the melting losses only. He called attention to the fact that in a stove foundry he found it very difficult to keep any record of the losses, mentioning that they swept the foundry every night, picked up all the scrap, riddled the sand, and extracted the chippings, etc. Every day's record was kept by itself, so that they knew absolutely all the time what they were doing. In this way, he found that there was about 4½ percent loss from all sources. The loss of silicon was only about ¼ of 1 percent, and the carbon loss very slight.

W. A. Jones, of Chicago, wanted to know what cupolas Mr. Keep used, and was told that they were of the old cylinder type. The same gentleman also asked if any data had been kept as to a comparison between the outlet of the tuyeres and the capacity of the blast pipe. He was informed that the area of the tuyeres is about two and three times as large as that of the blast pipe.



J. B. NAU.

David Spence, of the Greenlee Foundry Co., Chicago, asked the size of the tuyeres as they enter the cupola. Mr. Keep answered that in their No. 3 cupola the tuyeres are almost continuous. Nos. 1 and 2 cupolas, he added, have tuyeres 4½ in. by 7 in., each cupola being equipped with sixteen.

Notes on Pipe Foundries and Suggestions on Metal Mixers for Foundry Purposes.

Mr. J. B. Nau, of New York City, next read his paper entitled "Notes on Pipe Foundries and Suggestions on Metal Mixers for Foundry

MRS. CLARK FISHER AND DAUGHTER.

Purposes." While this paper contained a large amount of matter which was very interesting and which caused some discussion in the lobbies afterward, there was no official discussion upon it.

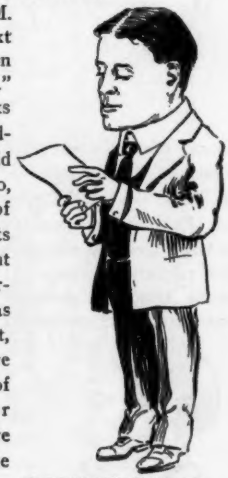
Retort Coke Melting Ratios.

C. M. Schwerin, of the Milwaukee Coke & Gas Co., Milwaukee, Wis., followed with his paper on "Retort Coke Melting Ratios." This paper proved very interesting to the members and was followed by considerable discussion. L. G. Blunt, of Pittsburg, asked if by increasing the quantity of coke on the charge from one to ten to one to seven, in both cases putting in a good bed, whether a cheaper grade of pig iron could be used. Mr. Schwerin's answer was that after a certain amount of coke had been put in there was no gain, but for very light work by pouring the iron hot, it had less tendency to take a sand chill. "It is true," he continued, "that a softer grade of iron can be used when running a high bed and keeping the melting points up than if the melting points were allowed to go too near the tuyeres by running a low bed or not putting sufficient coke on the charges, as the blast will oxidize the iron, making it harder."

C. M. SCHWERIN

Production Costs.

Mr. Ellsworth M. Taylor of Boston next read his paper on "Production Costs." Mr. Taylor's remarks were heartily applauded and Mr. David Spence, of Chicago, told of the method of keeping track of costs in vogue in the plant of which he is superintendent. It was thought expedient, however, to reserve further discussion of this subject for Thursday, when more members would be present.



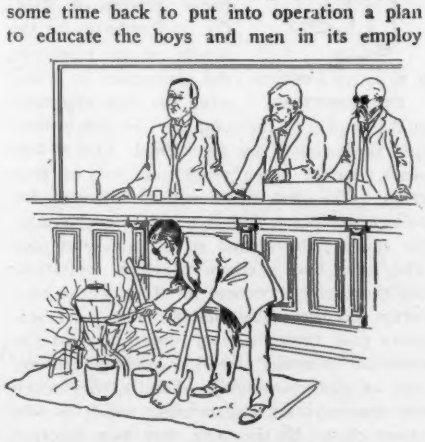
ELLSWORTH TAYLOR.

Making a Molder.

Henry M. Lane, of Cleveland, next read the paper entitled "Making a Molder," which was on the program for Wednesday afternoon but which was read and discussed Tuesday morning, so as to be sure and finish the discussion on other papers later in the week.

In the discussion that followed, August T. William, Philadelphia, told the convention that the firm with which he is employed undertook some time back to put into operation a plan to educate the boys and men in its employ

SOME OF THE REPRESENTATIVES OF THE PRESS.



A DEMONSTRATION OF THERMIT.

SOME OF THE WHISKERS AT THE CONVENTION.

along the lines suggested by Mr. Lane, and that the attempt was a signal failure. Mr. William was of the opinion that the influence of labor unions upon apprentices destroyed in a large measure the efforts of the employer in his educational work. The fact also that so many concerns confined their shops to the manufacture of specialties prevented the teaching of the molder's trade in all its details. To make a competent workman this speaker thought that manufacturers should adopt a plan by means of which a boy could, after learning all the details of the work in the shop of his first employer, be transferred to another shop, where a different product was made.

H. M. LANE ANSWERING QUESTIONS.

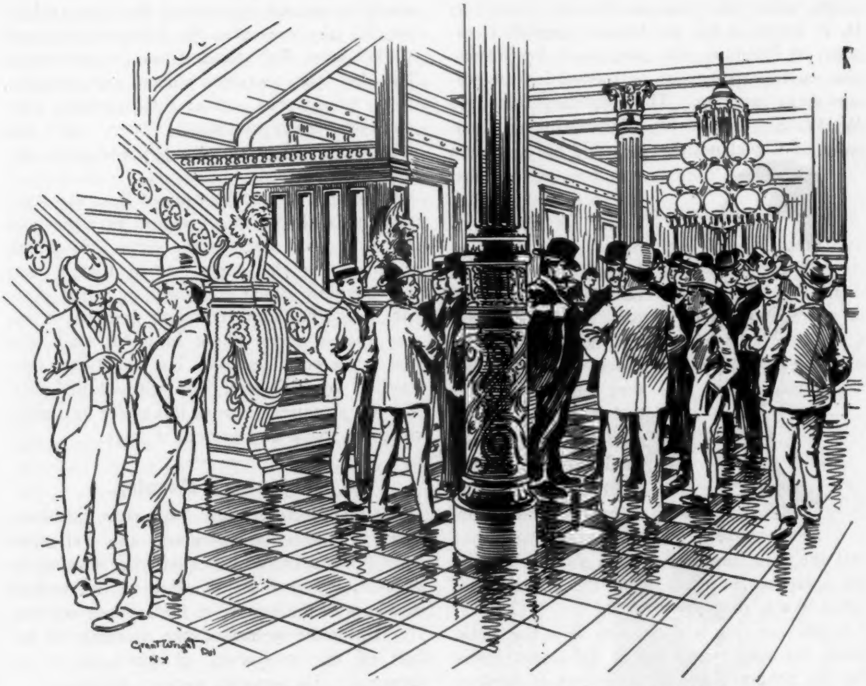
L. G. Blunt told of the technical school maintained by the Westinghouse Electric & Mfg. Co., at Pittsburg, for the benefit of its employes, the instructors in which were the best engineers in the employ of the company. In this institution, three classes are maintained. One of two years, one of three years and one of four years. The first mentioned is intended for college graduates, and is a sort of post graduate course; the second is for boys and men who have had a common school education, and the four-year course for those whose education has been very limited. The latter students pass through every department of the electrical company's works, learning the details of each thoroughly. Finally, they reach the dynamo test department, which is the senior class. By this time, they have received an excellent training in the manufacture and operation of electrical machinery and can be classed as first-class workmen.

In answering the above, Mr. Lane states that Mr. William evidently misunderstood the paper, as it would be impossible for any ordinary manufacturing concern to put into effect just the course outlined in the paper without going to a very great expense, and without the necessary books and preliminary training the experiment would be almost sure to fail.

GEO. H. HULL TALKS ON PIG IRON WARRANTS.

American Pig Iron Warrant System.

The session Tuesday afternoon was opened with a talk on the latest developments of the American Pig Iron Warrant System for foundry use, by George H. Hull, of New York. At the close of his talk Mr. Hull answered a number of questions concerning the working of the system.



LOBBY OF MURRAY HILL HOTEL, CONVENTION HEADQUARTERS.

Foundry Foremen's Session.

After the paper on Pig Iron Warrants President Wolff turned the meeting over to the Associated Foundry Foremen, vacating the chair to C. H. Thomas, president of the section. After a brief speech by Mr. Thomas Secretary Everitt read his report for the year.

Papers Read.

After the Secretary's report, Mr. Benjamin D Fuller, of Allegheny, read a paper entitled "Needed in the Business." As no discussion followed, David Spence, of Chicago was called upon to read his paper entitled "Things We Need in the Foundry." The gist of this paper was that instead of cutting one another's prices we should aim to make the very best quality of castings possible, and get a good price for them. Mr. Spence characterised cutting prices as one of the greatest evils the foundry business has to contend with; as it involves poor work, and slovenly methods in general.

E. B. GILMOUR.

A paper on "The Use of Plaster of Paris in the Foundry," by Edward B. Gilmour, of Peoria, Ill., was next taken up, and as there was no discussion this was followed by two papers by Archibald M. Loudon, of Elmira, New York, entitled "A Simple and Economical Method of Molding Propeller Wheels," and "A Successful Foundry Combination." In the discussion of the first paper, one man asked

AN INTERESTED TRIO.

Mr. Loudon if he knew of any cause in which a plaster of Paris match had been used for a pattern for a big propeller wheel. Mr. Loudon replied that plaster of Paris would be too expensive for this purpose.

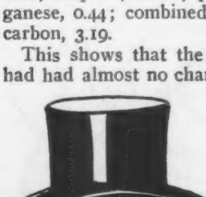
The paper on "Fan and Blower Tests," by H. E. Field, of the MacIntosh-Hemphill Company, of Pittsburg, was next read, but discussion on this paper was postponed for the session next morning. The Secretary then told W. W. Sly, of the Sly Manufacturing Company, of Cleveland, that he could have just ten minutes to present his paper on "Shot Iron," as the members were getting hungry and it would not do to keep them too long. Mr. Sly had not prepared his paper in writing before the meeting, but had had some analyses made and had tried some experiments to test the value of shot iron. He stated in brief that the shot iron was just as good as any of the scrap which came from the sprues, provided it was properly treated.

A. M. LOUDON.

If the shot iron is allowed to lie in the dump while the coke remaining in the dump burns out the shot will absorb an excess of sulphur and become so oxidized that it is worthless, but if the dump is thoroughly quenched the shot will not absorb sulphur, and will be as good as any other scrap from the cast.

Some of the analyses which Mr. Sly read were as follows: He took a grate bar and had both ends analyzed. The burnt end analyzed as follows: Silicon, 2.23; sulphur, 0.23; phosphorus, 0.838; manganese, 0.41; combined carbon, 0.36; graphitic carbon, 1.88. This gives a total carbon of 2.24. The unburned or stub end of the bar analyzed as follows: Silicon, 2.16; sulphur, 0.111; phosphorus, 0.819; manganese, 0.44; combined carbon, 0.07; graphitic carbon, 3.19.

This shows that the burned end of the bar had had almost no change in silicon, contained more than double the amount of sulphur, that the phosphorus and manganese were only changed slightly, and that the total carbon had been reduced over one percent. This loading of the iron with sulphur, and reduction of the carbon would be enough to damage the iron greatly. Mr. Sly also presented the following analyses of shot iron, and sprues from the same cast. The shot iron contained silicon, 1.90; sulphur, 0.077; phosphorus, 0.684; total carbon, 3.58; while the sprue contained silicon, 1.88; sulphur, 0.074; phosphorus, 0.57; and total carbon, 3.200 percent.



D. J. THOMAS.

From this it will be noticed that the composition is almost identical and that the shot is just as good scrap as the sprue. Mr. Blunt, in discussing the paper, stated that it was the magnetic oxide contained in burnt grate bars which rendered it useless, and that it was also the magnetic oxide in burnt shot iron that rendered it useless. He stated that they used all of their shot iron without difficulty. Mr. Sly promised to work this paper into more complete shape and present it later.

Wednesday Morning.

The main lecture room of the chemical laboratory of Columbia University was well filled when President Wolff called the meeting to order. Owing to the absence of the various members of the faculty at the summer schools, Dr. Moldenke welcomed the assembly in behalf of the institution, of which he is an alumnus. His remarks were as follows:

Mr. President, Ladies and Gentlemen.

I have been honored with the pleasant task of welcoming you to Columbia University. I have been asked to do so on behalf of this great institution because the dean and professors are all away with the summer classes in mine and mountain, shop and smelter, since the young men who are later on to manage our establishments are required to get into touch with actual conditions in business life as early and often as possible. They thus become of greater immediate value to you when they have left their Alma Mater.

I take peculiar personal pride in having been designated to receive you, as I myself am one of Columbia's sons, and as the Secretary of your great and important association, enjoy the distinction of being a resident lecturer to the classes here on Foundry Practice.

The twenty years that have passed since I was graduated from this institution of learning, have seen wonderful changes in America's university life. You behold the stately pile of magnificent structures, some of them still rising, all about you here. They are but the outward evidences of the work that is being done. Within these walls, in daily touch with

famous men of warm-hearted interest for each and every student, there is developed a culture which the university life gives the faithful searcher after truth. The personal element in the daily contact with men of splendid character, such as is always met with within our great universities and technical schools, becomes the chief element in forming the minds of our young men, and places them on the road of life, leading to solid and righteous citizenship.

Here in the laboratories, workshops and museums will be found everything that science and art can provide, to teach the principles underlying the utilization of Nature's forces for the good of man. All that a university can teach us, is, after all, only how to learn. How to observe correctly, make the proper deductions therefrom, and apply our knowledge to the best advantage. It is this training of the mind along the paths of logic, and correct thinking, that give the university bred man, if he is otherwise capable in business, the great advantage he enjoys, in being capable of filling important places earlier in life than has been the case heretofore. What does not ten years of life mean to us in these strenuous days.

It is the aim of all our universities and technical schools to train the youth of the nation to utilize our wonderful resources in the most economical way. Hence only the best methods for turning out high class material are taught. The student is made self-reliant, and learns to make the best use of what he finds, whatever the conditions may be that surround him. Thus do we aid in stemming the shameful waste of the nation's economic resources, and not only are we making good metallurgists and engineers, but high spirited citizens.

We will be taken through the mechanical and metallurgical laboratories later in the day, and see the many and varied appliances which facilitate the study of methods and results in our chosen field.

Columbia welcomes you as an educational association, and with us, wishes that we were not almost the only body of men seeking to elevate an industry which forms but one small part of the vast system on which rests the prosperity, and comfort of the world. Columbia invites you to send your sons to round off their characters and acquirements before entering the competition of man to man in the race for wealth and station. She wishes to see your good influence extended still further, and continue to benefit the great foundry industry even more than it has already done.

Columbia welcomes you one and all, hopes that when the day is over that it may be passed to the credit side of your experiences, and wishes you to keep her in warm remembrance, and use her resources wherever she may help you in the problems of your daily work.

Discussion on Fan and Blower Tests.

F. W. Stickle, of Waterbury, Conn., opening the discussion of the paper on "Fan and Blower Tests," read on the previous day by H. E. Field, Pittsburg, inquired whether the time of tapping the slag had been the same in both tests, and whether the volume of air had

CLINCHING THE ARGUMENT IN THE DISCUSSION ABOUT VENTLESS CORES.

been sufficiently uniform to insure the same conclusions.

Mr. Field replied that the work had been performed by trained men and that everything possible had been done to render the test absolutely correct. The volume of air had not been measured.

Mr. Stickle remarked that the catalogue figures of manufactures did not always agree with the actual volume of air furnished by their machines, and that in some cases the claims were purposely made lower than meas-

urements seemed to warrant. The power necessary to melt a given quantity of iron depended very largely upon the time required. He had found that while a certain volume of air is necessary, it is possible to double the output by increasing the volume furnished. The increased resistance due to rising temperature might also increase the power required very materially. In his opinion unsatisfactory results were very often due to failure to supply a sufficient volume of air. The best policy was always to melt the iron as rapidly as possible.

David Spence, of Chicago, asked about the number of ounces of pressure employed in the tests, and spoke of the influence of the physical properties of the coke upon the melting process. He had found that with a relatively light coke the melt proceeds more rapidly, apparently because the carbon is consumed more readily than is the case with a denser fuel. Referring to a custom of beginning the operation with 10 ounces blast pressure and increasing to 16 ounces, he personally believed that quite as rapid work could be done by keeping the pressure uniformly at 12 ounces.

Foundry and Pattern Shop Standards.

William H. Parry, Brooklyn, N. Y., read his paper at this meeting on "Foundry and Pattern Shop Standards," in which he urged the adoption of measures to secure greater uniformity in the matter of dimensions, draft, spindles, etc.

W. H. PARRY.

H. M. Lane, of Cleveland, said that he had for some time been trying to find out whether anything had been done toward the standardization of flasks. He had written a number of letters and had received many interesting replies. It had been suggested that the Association take the matter up. Some rational standards for snap flasks, pins and pin holes are especially desirable. He thought that what had been done in the case of standardizing the size of machine catalogues might also be done in foundry practice.

E. B. Gilmour, Peoria, Ill., suggested that the matter presented fewer difficulties than appeared at first sight.

Dr. Moldenke proposed that a committee be appointed devoted entirely to the interests of the patternmakers, a committee to report from time to time on standardization of patternshop-foundry practice. The motion was adopted. A second motion for similar action for the standardization of flasks aroused considerable discussion.

Benj. Fuller, Allegheny, Pa., said it would be difficult to tie down the foundryman to standard flasks. Flasks must be of such form as to accommodate the pattern. W. H. Parry disclaimed any intention to dictate as to size and shapes, but he saw no reason why something could not be done to eliminate odd sizes, sometimes involving differences of small fractions of an inch. August T. William endorsed Mr. Parry's remarks. He said it was often necessary to change the flasks for the molding machine every time a new pattern was used. Chas. J. Caley, Bridgeport, Conn., suggested that the motion be limited to flasks of certain sizes only. F. W. Stickle, Waterbury, Conn., believed in standardization in every way possible. He said that foundrymen had trouble enough without a lot of odd flasks. Eugene W. Smith, Chicago, thought that a standard in even inches could be set to which machine men could agree in time. One of the worst features of modern practice was, in his opinion, too much crowding of flasks.

The motion to provide a committee to look into the standardization of flasks prevailed.

H. M. Lane, Cleveland, gave a brief synopsis of his paper on the "Care and Storage of Patterns."

Paper on Thermit.

W. M. Carr of the Goldschmidt Thermit Co., New York, entertained the assembly with a practical demonstration of the use of thermit. He described the different kinds of this product, the variety used for ordinary welding being a mixture of metallic aluminum and iron oxide. When ignited, the oxidation of the aluminum produces an intense heat, in ordinary quantities approximating 5000 degrees F. or 3000 degrees C., the iron oxide being reduced to the metallic form. In order to show the

W. M. CARR.

intensity of the heat produced, a quantity of the material was ignited and the products of the reaction allowed to flow upon an iron plate, one inch thick, burning a hole through it instantly. A second experiment was a butt-weld of two sections of two-inch pipe. In the discussion which followed, Mr. Carr explained a number of interesting details connected with the manipulation of thermit. The reaction as ordinarily carried out produces about 50 percent of a mild form of steel containing about .1 percent of carbon derived from the graphite of the crucible. Nickel thermit is employed for the introduction of a definite quantity of nickel into cast iron or steel. About ½ percent of nickel in cast iron kettles increased the resistance to acids and alkalis to a marked degree. The demonstrator explained that while it was possible to use thermit in welding cast iron, it was in this case necessary to employ a larger proportion of the material than with steel.

A paper by G. N. Prentiss, Milwaukee, Wis., on thermit practice closed the morning session.

Noon Intermission.

At 12:30 the meeting adjourned until after dinner, and the members and guests repaired to the University Commons, where they were served with a substantial luncheon. One of the enterprising supply men had distributed little feathers upon which was printed "The J. D. Smith Foundry Supply Co. We don't stick our customers," and upon the end of which a burdock burr was attached. He had succeeded in making pretty much every one look like Indians, by the number of colored feathers that were attached to them. This feature and various other little tricks played by the supply men served to keep everybody in a good humor. The Obermayer Company distributed a little button with a piece of steel in the back so as to form a clicker or cricket, and these were in evidence everywhere by their clicking.

J. S. SMITH,
THE FEATHER MAN.

After luncheon the party assembled on the library steps where a photograph was taken. They then inspected the laboratories, admired the campus and buildings, and visited all parts of the university.

Afternoon Session.

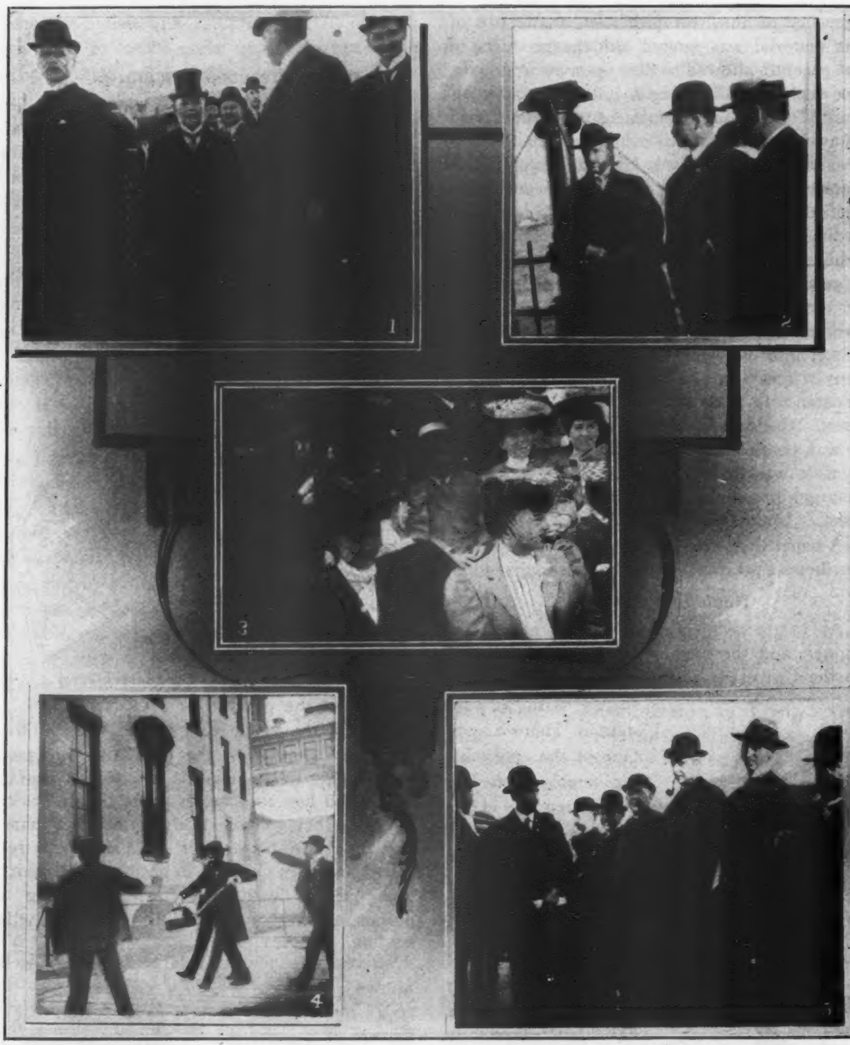
The afternoon session was called to order by the President at half past two. Several of the papers presented in the afternoon were illustrated by stereopticon. The first one was on "The Variation of the Properties of Alloys," by Percy Longmuir, of Sheffield, England. This was contributed by The Metal Industry, and read by Dr. Scholl. The lantern slides showed the apparatus used, photographs of the specimens, the microstructure of the different alloys, and a chart showing the results. There was no discussion of the paper though it had been extremely interesting to all present.

The next paper was a description of "The Use of Thermit in a Railroad Shop," by James F. Webb, of Elkhart, Ind. This was also illustrated by a number of lantern views. There was quite a little discussion of the paper, mainly in the shape of questions which Mr. Webb answered. In the discussion the fact was brought out that in his more recent work, Mr. Webb has used molds made of fire-brick, the bricks being chipped or cut to such a shape that they were fitted about the piece to be repaired and then clamped in position; the joints being closed with fire clay. By using a porous brick, such a mold is practically self-venting.

ONE OF SMITH'S
VICTIMS.

Microscopic views of a large number of well known varieties of core sands were a feature of a paper on "Core Sands," by J. S. Robeson, Camden, N. J. The author made clear that the occasional failure of cores prepared with any given binder was frequently due to the character of the core sand employed. He gave a number of successful formulæ and related several

LITTLE GRAINS OF
SAND.



1 AND 2 SNAP SHOTS ON THE FERRY. 3, BROWN WAS CHAIRMAN OF THE ENTERTAINMENT COMMITTEE AND LOOKED AFTER THE LADIES. 4, GOING TO THE SESSION. 5, A GROUP RETURNING FROM HARRISON.

experiences in which a slight modification of the mixture converted vexatious failures into conspicuous successes.

A discussion which caused more or less amusement concerned the possibility of casting cylinder jackets with cores without vents. One member remarked that it was all he could do to make cylinders of that kind with vents, to say nothing of ventless cores. The gentleman to whom the original claim that the thing could be done (P. M. Baumgardner, president The Holland Linseed Oil Co., Chicago), has been ascribed, failed to appear, and the discussion died for lack of opposition.

The next afternoon, however, when visiting the plant of the International Steam Pump Co., it was discovered that they were making jacket cores without vents, exactly as Mr. Baumgard-

ner had described to some of the members previous to Wednesday afternoon's session.

Thursday Morning.

With the exception of a discussion of about half an hour's duration on the paper read by Ellsworth M. Taylor of Boston, on "Production Costs," the meeting Thursday morning was devoted entirely to the election of officers for the coming year, and to the transaction of new and unfinished business. Mr. Taylor was given the opportunity by the president to answer any questions on the subject of his paper which any of the members might be interested in asking. Following the lead of August T. William of Philadelphia, the discussion took the line of whether it was advisable to keep a detailed system of the costs connected with the manufacture of small castings. The opinion prevailed among the foundrymen who participated in the discussion, and was coincided in by Mr. Taylor, that in a great majority of cases it is neither practicable nor advisable to attempt to do this; that where very small castings are concerned it is better to get a fair average cost and charge accordingly. A periodical check on the cost of manufacturing such castings every one or two years would be sufficient to keep the price in line. Mr. Taylor thought it would be a saving to the proprietor if such labor was put on the piece basis.

After the discussion ended, the convention voted its thanks to Mr. Taylor, on motion of Mr. William, for the very able manner in which he had answered the questions asked.

Metallurgical Report.

The report of the metallurgical section was next read by H. E. Diller, secretary, which is as follows:

During the past year your committee has formulated a method for determinating the silicon in cast iron, and is now at work on the question of the total carbon. The following is the method which your committee recommends to be the standard of the association, for the determination of silicon in pig iron and cast iron:

"Weigh one gramme of sample, add 30 c. c. nitric acid, (1.13 sp. gr.); then 5 c. c. sulphuric acid (conc.). Evaporate on hot plate until all fumes are driven off. Take up in water and boil until all ferrous sulphate is dissolved. Filter on an ashless filter, with or without suction pump, using a cone. Wash once with hot water, once with hydrochloric acid, and three or four times with hot water. Ignite, weigh, and evaporate with a few drops of sulphuric acid and 4 or 5 c. c. of hydrofluric acid. Ignite slowly and weigh. Multiply the difference in weight by .4702."

H. E. DILLER.

In recommending the above method, it was recognized that it is almost an impossibility to get chemists to use a standard method in their daily work. Hence the above method, as recommended, is intended primarily as a check method in case of dispute between different laboratories, or as between buyer and seller.

Hence a method, accurate in every point was sought, shortness being sacrificed to some extent to insure accuracy or the chance of error by a careless operator. Little in the above is left to the judgment of the chemist.

It will be further recognized that in the purchase and sale of pig iron or castings under specification, that standard methods are essential in order to allow the parties of both parts to make their determinations with the assurance that, on the score of method, they are on the same footing.

Miscellaneous Business.

Under the subject of new and unfinished business, Dr. Moldenke brought up the question of reducing the dues of the Association. He suggested this step not only as an inducement to increase the membership, but because he felt that since the discontinuance of the Journal the members were not getting full value for the $10 they were paying. To bring the matter to some sort of conclusion, he made a motion that the dues be reduced to $3 per year. This proposal was not favorably received and after some discussion the original motion was amended to make the annual dues $5, with the proviso that this amount be charged to members of the different sections

as well as to members of the Association. This was carried.

Following this action, the Association voted its thanks to Columbia University, to the contributors of the papers read, to the foundry supply men and to the entertainment committee.

The nominating committee, composed of W. A. Jones, of the W. A. Jones Foundry & Machine Co., Chicago, Ill.; J. P. Golden, Golden Foundry and Machine Co., Columbus, Ga.; George H. Lincoln, Lincoln Foundry Co., Boston, Mass.; C. H. Thomas, president of the Foundry Foremen's Section, and A. V. Slocum, National Car Wheel Co., Pittsburg, which was appointed at the Tuesday morning session, was called upon for its report.

In proposing Mr. West's name for president, the chairman of the committee, W. A. Jones, spoke in high praise of Mr. West's services to the association and of his work as an investigator and contributor of original articles on foundry practice. He said: "As chairman of the nominating committee, I am pleased to state that the Association has thought it wise to select at each of its conventions a gentleman whose home is the city in which the convention will next convene. In this way, the president will preside in his own city. This presents many advantages and as far as can be seen few disadvantages. And working with this end in view, it affords me great pleasure to place in nomination for president of this Association a gentleman whom you all know, a gentleman who is well known throughout this country where foundry interests are known or even discussed; whose books and papers have a national reputation, and a gentleman who perhaps more than any other person excepting alone, Dr. Moldenke, has done more and worked harder for the interests of this Association."

THOS. D. WEST.

The secretary was instructed to cast the vote of the convention for the election of Mr. West as president and for the election of the other candidates presented for the offices named. This was done and W. A. Jones and C. H. Thomas were appointed to escort Mr. West to the chair.

The customary expressions of appreciation and thanks for the honor were made by the incoming and outgoing officers, and following the precedent established at the first meeting, C. H. Wolff, the retiring president, was made an honorary member of the Association.

THREE FROM THE HUB.

The vice presidents elected for the ensuing year are as follows: New England States, Harry A. Carpenter, A. Carpenter & Sons, Providence, R. I. New York & New Jersey, H. Van Atta, Supt. J. L. Mott Iron Works, New York. Penn., Delaware, Maryland and District Columbia, A. V. Slocum, National Car Wheel Co., Pittsburg. Michigan, Ohio, Kentucky, Tennessee, A. K. Beckwith, estate of P. B. Beckwith, Dowagiac, Mich. Indiana, Illinois, Missouri, Kansas, Colorado, Arizona, New Mexico, Utah, Nevada and California, David Spence, Greenlee Foundry Co., Chicago. Wisconsin, Minnesota, Iowa, North Dakota, South Dakota, Idaho, Nebraska, Wyoming, Washington and Oregon, Adam Bair, superintendent of foundry, C. M. & St. P. Ry., Milwaukee, Wis. Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma and Texas, J. P. Golden, Golden Foundry & Machine Co., Columbus, Ga. Canada, T. J. Best, Warden, King & Co., Montreal.

Foundry Foremen's Section.

Chairman, David Reed, Canadian Westinghouse Co., Hamilton, Can.

Secretary, F. C. Everitt, J. L. Mott Iron Works, New York.

Metallurgical Section.

Chairman, R. S. MacPherran, J. I. Case, Threshing Machine Co., Racine, Wis.

H. J. MCCASLIN.

Secretary, H. E. Diller, Western Electric Co., Chicago, Ill.

Patternmakers' Section.

Chairman, H. J. McCaslin, Wellman-Seaver-Morgan Co., Cleveland.

Secretary, Wm. H. Parry, National Meter Co., Brooklyn, N. Y.
Auditing Committee.

J. S. Seaman, S. H. Stupakoff and Wm. Yearl, all of Pittsburg.

Invitations to hold the 1906 convention in Cleveland were received from the mayor, chamber of commerce, foundry foremen's society and several large manufacturing interests of that city, and were read by H. M. Lane, of Cleveland.

An invitation was also received from the Philadelphia Foundrymen's Association asking that the convention for 1907 should convene in that city.

WE ARE EXTENDED AN INVITATION TO MEET AT TORONTO.

Mr. L. L. Anthes, of the Toronto Foundry Co., of Toronto, Canada, also stated that the Canadians would be glad to have the Association meet with them in 1908, and that he hoped to present a formal invitation later for the 1908 convention to be held in Toronto.

The meeting adjourned, and in the afternoon the members visited the works of the International Steam Pump Co., Harrison, N. J.

Excursion to Harrison, N. J.

About a hundred of the members and guests of the association set out from hotel headquarters Thursday afternoon to visit the great plant of the International Steam Pump Co., at Harrison, N. J., under the guidance of Dr. Moldenke. Clear skies and brilliant sunshine made up for the disagreeable weather of the earlier days of the convention.

J. S. McCORMICK.

At the works the delegation was received and conducted about the establishment by representatives of the firm, and the busy scenes in and about the foundries, some familiar and others suggestive of improvements in home plants, were, to many, a welcome change from the hustle and bustle of New York streets.

An interesting feature in connection with the visit was a demonstration by the Goldschmidt Thermit Co. of the manner in which nickel thermit could be used for introducing nickel into iron or steel castings. They also demonstrated the use of ordinary thermit for heating the risers to keep them open.

As mentioned, those who had been carrying on the ventless core discussion found such cores in use at the plant. By the use of the proper sand, and a suitable binder they had succeeded in solving the difficulty.

The Convention Core Room.

In order to make things seem homelike at the convention, some of the supply men provided a very good working core room in the basement adjoining the grill room. The Thos. W. Pangborn Co. had the largest exhibit and centainly went to a great deal of trouble to make a remarkable display. They had a steam pipe brought from the boiler room and had one of the Hanna post screen shakers in operation riddling sand. In addition there was displayed a complete line of the several types of shakers made by the Hanna Engineering Works, of Chicago. Adjoining the post shaking screen exhibit they had an exhibit of the Hammer core machine. The machine was so connected that it could be driven either by motor or hand, and was in operation making the various sizes of cores. At the back of the space there was an exhibit of corundum wheels of various sizes and shapes, together with samples of corundum ore, showing the product as mined and manufactured by the National Corundum Wheel Co., of Buffalo, for whom the Pangborn Co. is exclusive Eastern sales agent. In fact, they hold an exclusive Eastern sales agency for each of the lines which they had on exhibition. Among points of especial interest in connection with the general supplies on exhibition by this company, there was a Williamson universal double swivel machinist's vise, which attracted considerable attention.

ARTHUR W. WALKER.

EXHIBIT OF THE THOMAS W. PANGBORN CO.

The Diamond Clamp and Flask Co.'s Exhibit.

This exhibit occupied a table in the center of the room, and consisted of one of their single pull universal belt shifters, and a core machine which has recently been designed and is now being perfected by this company. For agricultural machinery there are a large number of small cores required having a conical print on one end. To make these a machine has been devised in which the sand is fed to the machine by a spiral screw turned at right angles by a deflecting plate and forced out through an opening which can be turned down horizontally or placed in a vertical position. When the core is forced up vertical, its own weight tends to keep it in place. After the desired length has been forced out, a set of dies are brought together by a suitable lever so as to compress the lower end of the core, thus forming the print.

McCORMICK PUMPING VULCAN INTO REID.

This company also had a very neat souvenir in the form of a little folder, closed by one of their patent pattern dowels.

Exhibit of the Falls Rivet & Machine Co.

This company had on exhibit one of their 6-inch machines, which had been fitted up with a large fly wheel, so that it is possible to make 6-inch cores 24 inches long in 12 seconds by

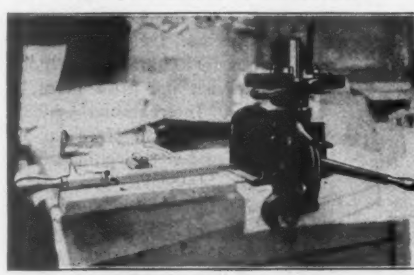


EXHIBIT OF THE DIAMOND CLAMP & FLASK CO.

EXHIBIT OF THE FALLS RIVET & MACHINE CO.

hand. They also had on exhibit a large number of odd sized and shaped cores which had been made with special dies, for different customers requiring special forms of cores. Some of these were very interesting indeed, and showed that a large amount of careful thought had been expended in designing the equipment for producing them.

Convention Notes.

While at this convention there was not the amount of sight-seeing, entertainment, etc., that has marked some of the previous gatherings, a number of the members stated that they had never seen so much interest taken in the papers read, and so much general discussion. Evening sessions had purposely been avoided in order that the members might have time to take in the various New York attractions. The supply men were conspicuous in heading parties to the various places of amusement. The sand men, the Smith crowd, and some others could undoubtedly give a pretty good account of everything that was doing at Coney Island.

S. D. THOMPKINS.

J. S. McCormick and some of his Pittsburg friends guided a large party to the Hippodrome one night, and in fact, every night saw a good number there.

Just to keep the Sly Mills in memory and to please his old friends, Mr. W. W. Sly appeared in the hotel lobby one day with a box under his arm and distributed aluminum cigar holders, each filled with three good smokes.

At the first day's session Mrs. Clark Fisher and her daughter were present. Mrs. Fisher owns and operates the Eagle Anvil Works, Trenton, N. J. She took a lively interest in the discussions, and in conversation with some of the members afterwards told a number of reminiscences which occurred at her own plant.

The members who were present at the Milwaukee Convention will remember Miss Ella M. Jones, whom many of them thought was probably the only woman in the United States running a foundry. It would be interesting to know how many foundries in the United States are owned or operated by women.

JOHN HILL.

Mr. John Hill, of the Hill & Griffith Co., Cincinnati, presented all of the members at the Columbia University meeting with a very ornamental watch fob from which was suspended a metal imitation of the barrel of the facings for which his company is famous.

Henry E. Pridmore and his faithful right hand man, D. E. Egan, made a half-mile sprint from the railroad station at Harrison to the plant of the International Steam Pump Co., so as to hold all the members up at the door that they might present each with a handsome gold pencil with their compliments. Unfortunately, Mr. Pridmore was so secretive in his movements that the cartoonist did not succeed in catching him. Probably Mr. Pridmore was too busy entertaining his friends.

Mr. S. D. Tompkins, of the Smooth-on Mfg. Co., was present at all of the sessions, and met many old friends, and made some new acquaintances.

Mr. Charles J. Caley, of the Russell & Irwin Co., of New Brighton, Conn., distributed a very useful souvenir in the shape of a case-hardened screw driver which was gold plated. The head of the screw driver had stamped on it in a very neat design, the trade mark of the Russell & Irwin Co.

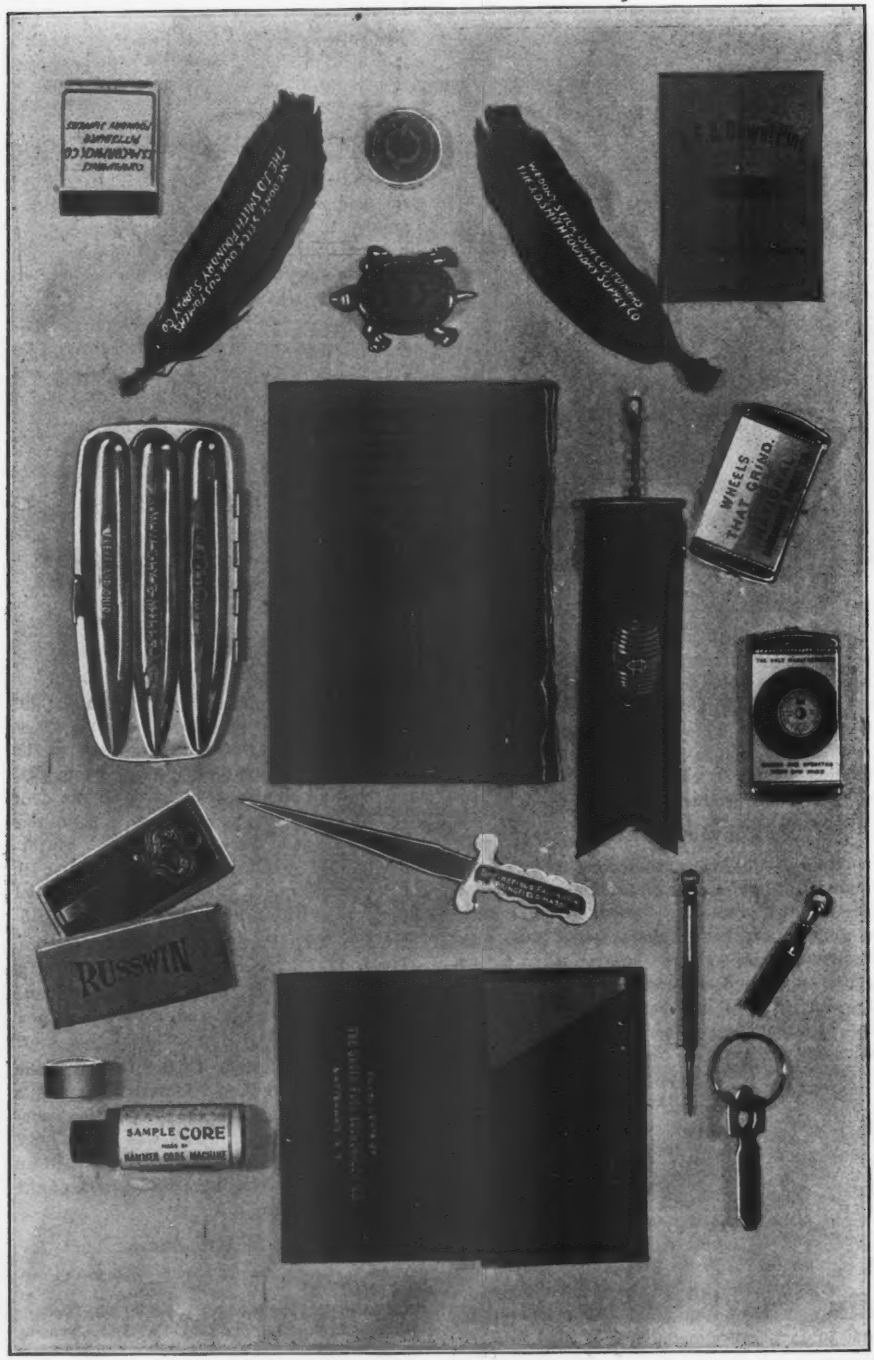
Those in Attendance.

Adamson, Robert, Farrell Fdy. & Machine Co., Ansonia, Conn.

Anderson, N., Matthew Addy & Co., New York.

Anthes, L. L., Toronto Fdy. Co., Ltd., Toronto, Can.

Ayers, E. M., Zanesville, O.



SOME OF THE SOUVENIRS.

Bair, A. W., C. M. & St. Paul Fdy., Milwaukee, Wis.
Bartlett, S. L., Elizabeth, N. J.
Baumgardner, P. M., president Holland Linseed Oil Co., Chicago.

W. W. SLY ASKS THE BOYS TO SMOKE UP.

Bean, A. P., The T. H. Symington Co., Corning, N. Y.
Bean, W. R., The T. H. Symington Co., Corning, N. Y.
Beckett, Jas. A., Hoosick Falls, N. Y.
Beckwith, A. K., Beckwith Estate, Dowagiac, Mich.
Beckwith, Mrs. A. K., Dowagiac, Mich.
Bell, Daniel, Dominion Coal Co., Glace Bay, N. S.
Bernhard, B., Garwood Foundry, Garwood, N. J.
Beverly, T. L., Cohoes Iron Fdy. Mach. Co., Cohoes, N. Y.
Blau, L. G., Golden Foundry & Machine Co., Columbus, Ga.
Blunt, L. G., Westinghouse Foundries, Pittsburg.
Blythe, Robert, Walker & Pratt Mfg. Co., Boston.
Bougher, J. K., J. W. Paxson Co., Philadelphia.
Bowe, Jas. J., Eddy Valve Co., Waterford, N. Y.
Bradford, Jas., Lord & Burnham Co., Irvington-on-Hudson.
Brant, W. J., Chicago Flour Co., Pittsburg.
Brewer, W. M., Colonial Fdy. & Machinery Co., So. Norwalk, Conn.
Brown, Aug. W., Abendroth Bros., Port Chester, N. Y.
Brown, L. K., L. K. Brown Molding Sand Co., Zanesville, O.
Brown, L. S., Springfield Facing Co., Springfield, Mass.
Bullard, H. W., Poughkeepsie Fdy. & Mach. Co., Poughkeepsie, N. Y.
Burgen, J. J., Lane Mfg. Co., Montpelier, Vt.
Burns, John C., Pond Pool Co., Plainfield, N. J.
Burr, John W., The Burr & Houston Co., Brooklyn.
Burr, Mrs. John W., Brooklyn.
Caley, Chas. J., Russell & Erwin Mfg. Co., New Britain, Conn.
Caley, H. L., Hart & Crouse Co., Utica, N. Y.
Carr, W. M., Goldschmidt Thermit Co., New York.
Carr, Mrs. W. M., New York.
Chapman, Eugene M., Wm. M. Crane Fdy. Co., Peekskill, N. Y.
Cherrie, Jas., Friction Pulley & Mach. Wks., Sandy Hill, N. J.
Clark, A. L., American Brake Shoe & Foundry Co., Mahwah, N. J.
Colvin, C. H., Colvin Foundry Co., Providence.
Cooledge, Edw. R., Thos. W. Pangborn Co., New York.
Crawford, Robt., S. L. Moore & Sons Co., Elizabeth, N. J.
Crivel, Geo. F., F. B. Stevens, Detroit.
Cunningham, W. P., American Bridge Co., Philadelphia.

D. F. EAGEN.

Cushing, Geo. H., H. B. Smith Co., Westfield, Mass.
Dancer, J. C., General Electric Co., Schenectady, N. Y.
Danziger, J. L., chemist, New York.
Davie, Jas., Acme Fdy. Co., Brooklyn.
Dette, W. S., The Arlington Co., New York.
DeWolfe, W. H., P. & F. Corbin, New Britain, Conn.
Diller, H. E., Western Electric Co., Chicago.
Dorman, Robert, Garwood Machine Co., Garwood, N. J.
Eagan, D. F., Pridmore Molding Machine Co., Boston.
English, W. C., *The Iron Age*, Boston.
Everitt, F. C., J. L. Mott Iron Works, New York.
Fasy, Jos. I., W. W. Lindsay & Co., Philadelphia.
Fenwinkle, W. A., Electric Controller & Supply Co., Cleveland.
Field, H. E., Mackintosh, Hemphill & Co., Pittsburg.
Findley, A. I., *The Iron Age*, New York.
Fisher, Harriet, Eagle Anvil Works, Trenton, N. J.
Fisher, S. H., Harrisburg Foundry & Mach. Wks., Harrisburg, Pa.
Fitzpatrick, Wm. M., The S. Obermayer Co., Pittsburg.
Folant, W. S., Colonial Fdy. & Mach. Co., So. Norwalk, Conn.
Foster, W. C., M. J. Drummond & Co., New York.
Fraser, John, Mackintosh, Hemphill & Co., Pittsburg.
Frohman, E. D., The S. Obermayer Co., Pittsburg.
Frohman, H. F., The S. Obermayer Co., Cincinnati.
Fuller, Benj. D., Westinghouse Elec. Co., Pittsburg.
Gartside, W. N., Diamond Clamp & Flask Co., Richmond, Ind.
Gilbert, H. P., Piqua Flour Co., Piqua, O.
Gilbert, H. W., N. Y. C. & H. Ry. Foundry, Frankfort, N. Y.
Gilbert, L. D., Frick Co., Waynesboro, Pa.
Gilmour, E. B., Globe Foundry Co., Peoria, Ill.
Gilmour, J., Foundry Equipment, New York.
Golden, J. P., Golden Foundry & Machine Co., Columbus, Ga.

A CONFAB BETWEEN CALEY AND SMITH.

Golden, Mrs. J. P., Columbus, Ga.
Golden, Miss Mamie, Columbus, Ga.
Golden, Miss Sara, Columbus, Ga.
Googins, C. E., Smooth-On Mfg. Co., Jersey City.
Gorman, J. W., Ridgeway Machine & Tool Co., Ridgeway, Pa.
Gow, John, General Electric Co., Schenectady, N. Y.
Graham, W. M., N. Y. Green Fuel Economizer Co., Matteawan, N. Y.
Griffiths, Geo. H., *The Iron Trade Review*, Chicago.
Grunau, W. F., Erie City Iron Works, Erie, Pa.

Gunn, John K., Utica Pipe Fdy. Co., Utica, N. Y.
Hamilton, Wm., Newport News S. B. & D. D. Co., Newport News, Va.
Hazeltine, Reginald, Magee Furnace Co., Boston.
Hessler, Geo. J., Syracuse Fdy. Co., Syracuse, N. Y.
Hill, J., The Hill & Griffith Co., Cincinnati.
Hirschheimer, L. C., La Crosse Plow Co., La Crosse, Wis.
Hockley, Rupert R., Abendroth Bros., Port Chester, N. Y.
Hockley, Mrs., Port Chester, N. Y.
Hodges, C. E., Utica Heater Co., Utica, N. Y.
Hooper, G. K., Con. Engineer, New York.
Hubbard, Geo. A., Chicago Flour Co., Chicago.
Hudson, J. M., president Piqua Flour Co., Piqua, O.
Hutton, C. E., Watt Mining Car Wheel Co., Barnesville, O.
Hutton, W. W., Advance Thresher Co., Battle Creek, Mich.
Jacobs, F. D., The Osborn Mfg. Co., Cleveland.
Johnston, S. T., The S. Obermayer Co., Chicago.
Jones, D., Barnett Foundry Co., Newark, N. J.
Jones, J. E., M. H. Treadwell Co., New York.
Jones, W. A., W. A. Jones Fdy. & Mach. Co., Chicago.
Juliem, J. Henry, J. W. Paxson Co., Philadelphia.
Kanavel, N. E., Interstate Sand Co., Cleveland.
Kaye, Ellsworth, J. S. McCormick Co., Pittsburg.
Keegan, J., United Eng. Foundry Co., Pittsburg.
Keegan, Mrs. J., Pittsburg.
Keep, W. J., Supt. Michigan Stove Co., Detroit.
Kelly, T. P., T. P. Kelly & Co., New York.
Kemp, Simon, Molding Sand Dealer, Catasauqua, Pa.
King, F. W., Corrugated Grinding Wheel Co., Philadelphia.
Knapp, L., Stiles Foundry & Supply Co., Parkersburg, W. Va.
Knapp, Mrs. L., Parkersburg, W. Va.
Knoeppel, John C., Oswego, N. Y.
Knoeppel, Mrs. John C., Oswego, N. Y.
Knoeppel, Frank W., Oswego, N. Y.
Lafever, M., Advance Thresher Co., Battle Creek, Mich.
Lambert, Edw. J., Syracuse Chilled Plow Co., Syracuse, N. Y.
Lambert, Mrs. Edw. J., Syracuse, N. Y.
Lane, H. M., editor *The Foundry*, Cleveland.
Langdon, Palmer H., *The Metal Industry*, New York.
Lent, Thos. K., Wm. M. Crane Co., Peekskill, N. Y.
Lincoln, Geo. H., Geo. H. Lincoln & Co., Boston.
Lincoln, T. M., Hartford Foundry Corp, Hartford, Conn.
Lindsay, E. C., W. W. Lindsay & Co., Philadelphia.
Logan, J. A., Jones & Laughlin Steel Co., Pittsburg.
Lord, Henry F., Lord & Burnham Co., Irvington-on-Hudson.
Loudon, Arch. M., Elmira Heater Co., Elmira, N. Y.
Loudon, Mrs. Arch. M., Elmira, N. Y.
Lyon, E. J., Brown & Sharpe Mfg. Co., Providence.
McCardell, Andrew, Pond Machine & Tool Co., Plainfield, N. J.
McCartney, J. T., Watt Mining Car Wheel Co., Barnesville, O.
McCaslin, H. J., Wellman-Seaver-Morgan Co., Cleveland.
McClintock, H. E., National Founders' Association, Detroit.
McCormick, J. S., J. S. McCormick Co., Pittsburg.
McFadden, W. H., Mackintosh, Hemphill & Co., Pittsburg.
McKenna, Chas. J., New York.
McLaren, John, Phillips & McLaren, Pittsburg.
McLean, E., Penn. R. R., Altoona, Pa.
McLean, Martha, Altoona, Pa.
McLeod, Robt., Newark, N. J.
McNeal, G., Garden City Sand Co., Chicago.
McPhee, H., Eaton, Cole & Burnham Co., Bridgeport, Conn.

E. A. MUMFORD.

McPhee, L., Eaton, Cole & Burnham Co., Bridgeport, Conn.
McPhee, N. H., Eaton, Cole & Burnham Co., Bridgeport, Conn.
McPhee, Mrs. Bess, Bridgeport, Conn.
McQuillin, W. S., Colonial Fdy. & Machinery Co., So. Norwalk, Conn.
MacDougalt, D., National Meter Co., New York.
Maher, Edw., Maher & Flockhart, Newark, N. J.
Malone, T. E., J. S. McCormick Co., Pittsburg.
Marceau, L. E., Abendroth Bros., Port Chester, N. Y.
Marceau, Mrs. E., Port Chester, N. Y.
Martin, Geo. H., Rand Drill Co., Ossining, N. Y.
Matthews, C. D., Camden Iron Works, Camden, N. J.
Meeker, David M., Meeker Foundry Co., Newark, N. J.
Meighan, John A., John A. Meighan, Pittsburg.
Meighan, Mrs. John A., Pittsburg.
Miller, A. J., Whitehead Brass Co., Providence.
Millett, E., Millett Core Oven Co., Springfield, Mass.
Mills, C. E., C. E. Mills Oil Co., Syracuse, N. Y.
Mills, J. F., Abendroth Bros., Port Chester, N. Y.
Mills, Mrs. J. F., Port Chester, N. Y.
Moldenke, Dr. R., secretary American Foundrymen's Association, Watchung, N. J.
Moldenke, Mrs. K., Watchung, N. J.
Morehouse, W. S., A. S. Cameron Steam Pump Works, New York.
Morse, H. R., The W. W. Sly Mfg. Co., Cleveland.
Mumford, E. A., E. A Mumford Co, Philadelphia.
Murphy, Hallet M., Eaton, Cole & Burnham Co., Bridgeport, Conn.
Nanert, Herman, Ridgeway Dynamo & E. Co., Ridgeway, Pa.
Newcomb, F. F., Crocker Bros., New York.
Nicol, Jas., Iron & Brass Works, Sandy Hill, N. J.
Norton, Jas. H., The Burr & Houston Co., Brooklyn.
Overton, C. J., The Winkle Co., Hartford, Conn.
Pangborn, John C., Thos. W. Pangborn Co., New York.
Pangborn, Thos. W., Thos W. Pangborn Co., New York.
Parry, W. H., National Meter Co., Brooklyn.
Pennewill, E. E., Abram Cox Stove Co., Philadelphia.
Perrine, W. A., Abram Cox Stove Co., Philadelphia.
Perry, Walter, Farrell Foundry & Machine Co., Ansonia, Conn.
Pettinos, Chas. E., Pettinos Bros., Bethlehem, Pa.
Pettinos, Geo. A., Pettinos Bros., Bethlehem, Pa.

Pridmore, Henry E., Henry E. Pridmore, Chicago.
Quinn, Hugh T., Eaton, Cole & Burnham Co., Bridgeport, Conn.
Raucherberg, E. C., Wheeling Mold & Foundry Co., Wheeling, W. Va.
Reardon, W. J., Westinghouse Foundry, Pittsburg.
Reese, John, Falls Rivet & Machine Co., Cuyahoga Falls, O.
Reid, David, Canadian Westinghouse Co., Hamilton, Can.
Rider, I. G., Frick Co., Waynesboro, Pa.
Rider, Mrs. I. G., Waynesboro, Pa.
Robeson, J. S., American Glutrose Co., Camden, N. J.
Roedell, W. A., Kennedy Valve Mfg. Co, Coxsackie, N. Y.
Savage, Wm. F., Smith & Anthony Co., Boston.

J. J. BURGER.

Sayles, N. W., American Brake Shoe & Fdy. Co., Mahwah, N. J.
Schade, G. C., Braddock Machine Mfg. Co., Pittsburg.
Schaffer, J. H., National Corundum Wheel Co., Buffalo.
Schilling, Jos., Russell & Erwin Mfg. Co., New Britain, Conn.
Scholl, Geo. P., *The Metal Industry*, New York.
Schroeter, J. A., Western Foundry Co., Chicago.
Schwerin, C. M., Milwaukee Coke & Gas Co., Milwaukee.

AFTER A HOT DISCUSSION AT ONE OF THE SESSIONS.

Sherman, Wm. J., Bethlehem Steel Co., Bethlehem, Pa.
Sickels, W. H., A. A. Griffing Co., Jersey City, N. J.
Sleeth, S. D., Westinghouse Air Brake Co., Pittsburg.
Slocum, A. W., National Corundum Wheel Co., Pittsburg.
Sly, W. W., The W. W. Sly Mfg. Co., Cleveland.
Smith, Eugene W., Crane Co., Chicago.
Smith, F., Nelson Valve Co., Philadelphia.
Smith, J. S., J. D. Smith Foundry Supply Co., Cleveland.
Smith, M. Sheldon, Globe Foundry Co., Port Chester, N. Y.
Smith, P. C., Ingersoll-Sergeant Co., Easton, Pa.
Spence, David, Greenlee Foundry Co., Chicago.
Stafford, Wm. H., Gibby Foundry Co., E. Boston, Mass.
Stearns, Geo. H., Walker & Pratt Mfg. Co., Boston.
Steele, W. O., Bateman Mfg. Co., Grenloch, N. J.
Stehman, John V. R., Birdsboro Fdy. & Mach. Co., Birdsboro, Pa.
Stehman, Mrs. J. V. R., Birdsboro, Pa.
Stickle, F. W., Manufacturers' Foundry Co., Waterbury, Conn.
Stickle, Mrs. F. W., Waterbury, Conn.
Stone, H. H., Penn. R. R., Altoona, Pa.
Stutz, E., Goldschmidt Thermit Co., New York.
Tabor, Harris, Tabor Mfg. Co., Philadelphia.
Taggart, Edw. M., J. W. Paxson Co., Philadelphia.
Tatlock, W. L., Rand Drill Co., New York.
Taylor, Ellsworth M., Library Bureau, Boston.
Taylor, J. A., Port Chester, N. Y.
Thomann, Chas., Crosby Steam Gauge Co., Boston.
Thomas, Chas. H., Associated Fdy. Foremen, New York.
Thomas, D. J., Sterit-Thomas Foundry Co., Pittsburg.
Thompkins, S. D., Smooth-On Mfg. Co., Jersey City, N. J.
Thompkins, Vreeland, Smooth-On Mfg. Co., Jersey City, N. J.
Thompson, A. M., Link Belt Machinery Co., Chicago.
Thompson, Mrs. A. M., Chicago.
Thompson, Frank, T. P. Kelly & Co., New York.
Touceda, Enrique, Albany, N. Y.
Trimble, F. W., Whiting Foundry Equipment Co., New York.
Turnbull, R. E., Henry E. Pridmore, Chicago.
Turney, Jas., H. B. Smith Co., Westfield, Mass.
Tutein, E. A., Crocker Bros., Boston.

W. A. RODDELL.

Vanatta, H., J. L. Mott Iron Works, New York.
Vanderford, Asa, Crescent Iron Works, Springfield, Mo.
Wadsworth, Geo. H., Falls Rivet & Machine Co., Cuyahoga Falls, O.
Waldorf, Henry J., Eaton, Cole & Burnham Co., Bridgeport, Conn.
Waldron, M. D., Utica Heater Co., Utica, N. Y.
Waldron, Mrs. M. D., Utica, N. Y.
Waldron, Miss L., Utica, N. Y.
Walker, Arthur W., Walker & Pratt Mfg. Co., Boston.
Walker, Geo. B., Whitehead Bros. Co., New York.
Walker, Mrs. J. W., New York.
Warren, D. C., *The Foundry*, New York.
Watt, Stewart, Watt Mining Car Wheel Co., Barnesville, O.
Webb, Jas. F., Lake Shore R. R. Co., Elkhart, Ind.
Webb, Mrs. J. F., Elkhart, Ind.
Weeks, A. B., Cambria Steel Co., Johnstown, Pa.
Weeks, S. C., Lorain Steel Co., Johnstown, Pa.

West, Thos. D., Thos. D. West Fdy. Co., Sharpsville, Pa.
Wilke, F. A., General Electric Co., Schenectady, N. Y.
William, A. T., Enterprise Mfg. Co., Philadelphia.
William, Mrs. A. T., Philadelphia.
Williams, Sidney M., A. & B. Brown Co., Elizabeth, N. Y.
Winlock, J. P., Barbour-Stockwell Co., Cambridge, Mass.
Wolff, Chris. J., L. Wolff Mfg. Co., Chicago.
Young, Jas., Penna. R. R. Co., Altoona, Pa.

Convention Notes.

The J. S. McCormick Co., of Pittsburg, published a very neat souvenir program of the convention, containing half tones made from the photographs taken at each one of the meetings, from the Philadelphia meeting in 1896 to the Indianapolis meeting of 1904. The half tones are remarkably good, so that the people can be recognized.

The Green Fuel Economizer Co., of Matteawan, N. Y., presented the members with a

THOMAS D. WEST, PRESIDENT OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION.

very neat card case, containing a memorandum book in one of the pockets.

The Thos. W. Pangborn Co. presented each one of the members with a very neat match safe, with the compliments of the National Corundum Wheel Co., of Buffalo, N. Y., for whom the Thos. W. Pangborn Co. are Eastern sales agents.

The J. W. Paxson Co., of Philadelphia, are not as slow as their souvenir might indicate. The souvenir referred to is an exceedingly neat little cast iron turtle, having attached to his back a sheet of celluloid upon which it is stated: "It is now fifty years since we first learned to crawl. The J. W. Paxson Co."

The Springfield Facing Co., of Springfield, Mass., gave away an aluminum letter opener of very neat design.

FOUNDRY FACINGS.

BY W. G. SCOTT, RACINE, WIS.

Under the head of "Foundry Facings" may be included the following material, viz.:

Plumbago, graphite or black lead;
Soapstone or talc;
Sea coal or bituminous facing;
Hard coal or anthracite dust;
Coke dust;
Wood charcoal;
Lycopodium;
Parting sand, mill dust, etc.

The object of a facing is to prevent the sand from adhering to the casting and to produce a smooth surface on the iron.

It must be of a refractory nature and not burn away before the molten metal; it must also adhere to the surface of the mold and cause the castings to "peel" readily when shaken out of the sand.

Such material may be termed a refractory facing and is, literally speaking, a true facing.

Graphite, often called plumbago, black-lead, or silver-lead, stands at the head of the refractory facings.

Soapstone or talc is another refractory material, but owing to certain objectionable features, to be described later on, is seldom used alone as a facing, yet is often present as an adulterant in many cheap facings.

Coke dust and hard coal (anthracite dust) are occasionally found to be present as an adulterant of graphite and, owing to the fact that they are nearly pure carbon, it is a difficult matter for the foundryman to detect the fraud.

Another class of facings, termed combustible facings, are used to prevent the fusion of the molding sand, and instead of being applied to the face of the mold the material is mixed with the sand, consequently is a "mixer" instead of a facing.

Sea coal facing belongs to this class and is the only facing known which is not put on the face of the mold.

It is generally mixed in the proportions of one shovel full of the pulverized coal to five, up to twenty shovels of sand, according to the size and weight of the casting to be made.

The coal is mixed with that portion of the sand which is nearest to the surface of the mold, in order to "rot" or break up the particles of sand coming in contact with the fluid iron.

The heat from the red hot iron attacks the coal, consuming much of it, and allows the gas to escape by way of the porous interstices, otherwise the sand would be fused to a glass like mass.

Sand mixed with coal is generally called "facing sand," and as only a small depth of such sand is needed, the molder should use some judgment as to the proper thickness.

Anthracite coal dust, also coke dust, are sometimes used in place of soft coal facing.

Another class of material often spoken of as facings, include such substances as wood charcoal, lycopodium, parting sand, mill dust, etc.

Such material being used for "parting" can not be termed a facing, but on account of their use in connection with the true facings this article would not be complete unless they were given some attention.

Facings are applied in different ways, according to the class of work, the kind of mold (dry or green sand) and the idea of the workman.

In some cases the graphite, clay, etc., is mixed with weak molasses water, stale beer or other similar binder or sizing and applied to the face of the mold, the surface being finally "slicked" by means of a proper tool.

Such treatment generally applies to dry sand molds and cores, but in green sand work where the mold already contains moisture, the facing is dusted on by means of a "dust bag" or with a camel hair brush, then the excess of facing removed with the hand bellows.

As before stated, the object of a "facing" is to produce a perfect separation of iron and sand, while the object of a "parting" material is to facilitate the separation of the matched parts of the upper and lower parts of the mold (cope and drag), therefore the essential properties of a "parting" material are non-adhesiveness and proof against moisture.

It is not the object of this paper to go into the details of applying and using facings, etc., but to describe the different grades of material and give a suitable method for testing the quality—therefore each class of such material will be considered in its proper place.

Sea Coal Facing.

Sea coal facing should be made from the very best quality of soft coal, free from slate, sulphur, phosphorus and other detrimental impurities.

The best "gas coal" makes the best sea coal facing and as the Youghiogheny district furnishes the most perfect product, an analysis of such will give a good idea as to the proper composition.

DR. RICHARD MOLDENKE, SECRETARY AMERICAN FOUNDRYMEN'S ASSOCIATION.

(1) Proximate analysis of Youghiogheny gas coal:

Moisture	1.00	percent.
Volatile matter	= 35.00	"
Fixed carbon	= 58.07	"
Sulphur	= .33	"
Ash	= 5.60	"

This coal has a specific gravity of 1.280 compared with distilled water as 1.000.

The amount of coke produced from the above would be 63.67 percent.

(2) Cannel coal is frequently used for facing and by some founders is preferred to the Youghiogheny.

The analysis is as follows:

Moisture	= 3.30	percent.
Volatile matter	= 48.50	"
Fixed carbon	= 42.00	"
Sulphur	= .20	"
Ash	= 6.00	"

This coal has a gravity of 1.229 and produces about 48.00 percent of coke.

The volatile matter is extremely high, and owing to its oily nature it is a question as to its fitness for a good facing.

The above analyses are supposed to represent the average composition of such coals, but all coal is subject to variation, especially in regard to the amount of moisture and volatile matter present.

Sulphur is a detrimental ingredient in coal

and if high is liable to cause the surface of the iron to be hard, producing what is called a "sulphur skin" on the casting.

Phosphorus is seldom present in quantity sufficient to affect common cast iron.

In making an analysis of sea coal facing, the particular points to be noted are sulphur and ash.

If the sulphur exceeds 0.75 percent it may be assumed that an inferior grade of coal has been substituted, and if above 1.50 percent the facing may be looked upon with suspicion.

Where the ash exceeds 8.00 percent, it is evident that some slaty material is present, but the facing should not be condemned on this account unless the ash exceeds 11.00 percent.

The poorer grades of coal contain a large amount of sulphur, varying from 1.50 to 7.50 percent, and the ash in certain cases is extremely high.

Slack, culm, etc., are often ground up for facings and as an adulterant for sea coal, in which event the increase in ash is a guide as to the quality, some grades of slaty coal, slack and culm having as high as 33.00 percent of ash.

Graphite Facing.

The purest graphite contains about 99.90 percent of carbon. Such material, however, is too expensive to be used as a facing, owing to the fact that it is necessary to purify the natural product in order to obtain this high purity.

A superior natural graphite much used for facings contains about 75.00 percent of carbon, and is used for high class work.

Inferior grades of natural graphite contain carbon varying from 15.00 to 65.00 percent, and as the regulation method of determining carbon in facings consists in burning off a weighted amount of the sample and calling the loss carbon, it is an easy matter for the unscrupulous dealer to add a certain amount of coke or anthracite dust so as to raise the carbon content to a point equal to that of a commercially pure graphite.

There are several methods for determining this sort of adulteration, but they are not absolutely reliable.

If we fill several small beakers with water and then from the end of a spatula carefully sprinkle pure graphite, coke dust, anthracite dust, soft coal dust and wood charcoal on the surface of the liquid it will be found that none of the powders will settle except coke dust and some charcoals.

The reason for this is that the oily or greasy matter forms a film on the surface of the water and prevents settling, consequently this test only distinguishes coke and non-greasy charcoal.

By shaking in a test tube, about a quarter of a gram of the powder mixed with 15 c. c. of acetone, and allowing to stand ten or fifteen minutes it will be observed that pure graphite settles clear, leaving the liquid colorless; coke dust imparts a gray color to the solution and remains in suspension a long time; anthracite dust imparts a faint brown color, and settles more rapidly, while soft coal dust imparts a deep brown color to the acetone.

Equal parts of glacial acetic acid and sulphuric ether answer as well as acetone for such a test.

The above tests are qualitative only and of no value as a quantitative method.

The regulation method used in the analysis of facings is known as a "Proximate Analysis" and is the same as that used for coal.

The following analysis of graphite, coke dust, coal and charcoal will give a general idea as to the peculiar character of the different forms of carbon.

The purest graphite designed for commercial purposes seldom exceeds 99.00 percent in carbon as previously stated, but it is possible to obtain what is termed "commercially pure" graphite containing about 95.00 percent of carbon, and such material is used to a great extent as a lubricant.

For facing purposes the carbon content is generally lower, varying from almost nothing up to 75 percent.

The following proximate analysis also gives some idea as to the different grades.

Sulphur may be stated as a separate quantity or included in the analysis by subtracting half of the amount from the volatile matter and half from the fixed carbon, therefore if preferred the sulphur may be considered separate and the analysis made good by adding half the sulphur to the volatile and fixed carbon content.

(3) Analysis of pure graphite—C. P.:

Moisture	=	.02	percent.
Volatile matter	=	.09	"
Fixed carbon	=	99.79	"
Sulphur	=	none	
Ash	=	.10	"

(4) Analysis of commercially pure graphite:

Moisture	=	.15	percent.
Volatile matter	=	.79	"

Fixed carbon	= 94.60 "
Sulphur	= trace
Ash	= 4.46 "
Specific gravity	= 2.293

(5) Analysis of "stove plate" graphite facing:

Moisture	= .75 percent.
Volatile matter	= 5.29 "
Fixed carbon	= 56.10 "
Sulphur	= .20 "
Ash	= 37.66 "
Specific gravity	= 2.363

The composition of the ash (37.66 percent) is as follows:

Silica	SiO_2	= 25.60 percent.
Alumina	Al_2O_3	= 5.25 "
Iron oxide	Fe_2O_3	= 4.94 "
Lime	CaO	= 1.07 "
Magnesia	MgO	= .80 "

(6) Analysis of cheap, "green sand" facing:

Moisture	= .45 percent.
Volatile matter	= 5.75 "
Fixed carbon	= 41.49 "
Sulphur	= .62 "
Ash	= 51.69 "
Specific gravity	= 2.489

The following is an analysis of the ash:

Silica	SiO	= 32.13 percent.
Alumina	$Al\ O$	= 2.77 "
Iron Oxide	$Fe\ O$	= 6.78 "
Lime	CaO	= 1.69 "
Magnesia	MgO	= 8.32 "

This sample was said to contain 25 percent of soapstone.

Now, if we conclude the maximum amount of magnesia in a natural graphite to be 1 percent and use the factor 3.144 we would obtain 22.17 percent of soapstone as an adulteration. (Thus: Subtracting 1.00 percent from 8.32 and multiplying the magnesia by 3.144 we get the above result.)

If, however, we conclude that there is no magnesia in the ash of a graphite and use the old factor of 3 then we obtain 24.96 percent.

The price of the "commercially pure" graphite (analysis — 4) was given as 8½ cents per pound; that of the "Stove Plate" facing as 6 cents, and of the "cheap" as 3½ cents.

The following analysis of coke dust, anthracite, common soft coal and charcoal are given for comparison, also analyses of soapstone:

(7) Analysis of coke dust:

Moisture	= .19 percent.
Volatile matter	= 1.40 "
Fixed carbon	= 86.89 "
Sulphur	= .98 "
Ash	= 10.54 "
Specific gravity	= 1.886

(8) Analysis of anthracite coal dust:

	Selected Lump	Screenings.
Moisture	= .05 percent.	3.50 percent.
Volatile matter	= 4.40 "	8.99 "
Fixed carbon	=92.00 "	68.70 "
Sulphur	= .57 "	.86 "
Ash	= 2.98 "	17.95 "
Specific gravity	= 1.565	1.590

(9) Analysis of steam coal (soft coal):

	Selected Lump.	Screenings.
Moisture	= 1.39 percent.	4.44 percent.
Volatile matter	=33.82 "	32.79 "
Fixed carbon	=58.68 "	37.61 "
Sulphur	= .96 "	3.10 "
Ash	= 5.15 "	22.06 "
Specific gravity	= 1.321	1.486

(10) Analysis of wood charcoal:

	Common Variety.	Medicinal.
Moisture	= 3.83 percent.	3.66 percent.
Volatile matter	=26.57 "	33.15 "
Fixed carbon	=66.63 "	58.52 "
Sulphur	=none "	none "
Ash	= 2.97 "	4.67 "
Specific gravity	= 1.362	1.412

(11) Analysis of Soapstone and Talc:

		Vermont Soapstone.	French Steatite or Talc.
Silica	SiO_2	= 51.20 percent.	61.85 percent.
Alumina	Al_2O_3	= 5.22 "	2.61 "
Iron Ox.	FeO	= 8.45 "	.25 "
Lime	CaO	= 1.17 "	trace "
Magnesia	MgO	= 26.79 "	34.52 "
Water	H_2O	= 7.17 "	.77 "

It will be noticed that there is a material difference in the amount of "volatile matter" in the different carbon compounds; pure graphite being very low in this respect, while soft coal and charcoal are extremely high.

It would appear from this that the determination of volatile matter was conclusive proof of the presence of coal, and would be if soft coal were used as an adulterant, but hard coal and coke having a low volatile matter content might be mistaken for a natural graphite high in ash, containing a similar amount of combined water.

A chemist reporting the presence of coal in a graphite facing, by deduction of volatile matter, might be in error, and the chances are that an injustice would be done the facing manufacturer.

Samples No. 5 and 6 were reported by a young chemist as containing no graphite, a postitive statement being made that the carbon present was hard coal or coke dust.

The "supply house" objected to such decision and proved that No. 5 was natural graphite free from adulteration, and that No. 6 was the "mine run" of natural graphite mixed with 20 to 25 percent. of soapstone, consequently the amount of volatile matter is not a reliable method for the presence of anthracite coal or coke dust.

Coke dust (free from oil, etc.) sprinkled on the surface of water will gradually sink, a distinction from graphite, soft and hard coal, which floats.

Difference in volatile matter differentiates coke from charcoal, and the following method devised by the author furnishes a distinctive test for the presence of anthracite coal in graphite.

Treat 0.5 gram of the sample with 50 c.c. of strong nitric acid, boiling for about ten minutes, then add 0.5 gram of pulverized potassium chlorate and boil until most of the chlorine is off.

Dilute with 30 c.c. of cold water and filter, reserving the filtrate for examination.

The filtrate from pure graphite treated in this manner should be clear and colorless, unless iron be present, in which case it may be somewhat yellow in color.

The filtrate from any kind of coal and charcoal will have a distinct amber-brown color, the soft coals giving a deeper color than the hard coals or charcoal.

To confirm the test, add 30 c.c. of stannous chloride solution and note the change in color.

The graphite filtrate will be reduced to a colorless liquid if iron be present or remain unchanged if free from iron; whereas the filtrate from coal having an amber color will be much deeper in color and in some cases nearly black.

The only precaution to be observed in this test is sufficient boiling to remove all of the hydrocarbon coloring matter in the coal.

A quantitative method giving approximate results close enough for practical purposes may be made by running a standard sample of anthracite dust along with the sample of facing and comparing the color in similar manner as to that of colormetric carbon in steel analysis.

Usually 0.2 gram of anthracite dust (previously passed through a 100 mesh sieve) is treated with 50 c.c. of nitric acid, the potassium chlorate added and both solutions boiled for the same length of time (20 to 30 min.) then diluted with 30 c.c. of water and filtered.

The "standard" is then made up to 200 c.c. or other suitable measure for comparison with the "sample."

In regard to soapstone it may be said that the determination of magnesia is the only method to be relied upon for detecting the addition of this substance.

Soapstone used alone as a facing is objectionable on account of imparting to the face of the castings a chalk-white color, givthem the appearance of being whitewashed.

Mixed with graphite or anthracite dust it answers very nicely for certain classes of work, especially hollow ware and similar thin castings.

Facing made entirely of anthracite dust or mixed with low grade natural graphite is termed "Mineral Facing" and is generally represented by one or more of the letters **X** to designate the fineness.

Such facings answer fairly well for general foundry work where a particularly smooth surface is not required, and is merely dusted on the mold to save the labor of cleaning the casting.

Car wheels and work of similar nature which have to be annealed are usually treated with mineral facing.

In concluding the remarks on "facings" it may be said that each particular kind of facing has its proper place; thus, sea coal is meant to be mixed with the sand in proper proportions, bearing in mind that too much sea coal causes cold shuts, streaked iron, etc., and that not enough used will cause the sand to adhere to the mold.

Gas coal, if not too high in volatile matter, makes the best facing for this purpose.

For work that has to be "slicked" and where a fine finish is desired, the best graphite facing should be used.

All facings should be kept in a dry place as they readily absorb moisture.

Parting Material.

The material generally used for parting purposes is "parting sand," "mill dust," charcoal and lycopodium.

Parting sand needs no description, as it is an ordinary sharp sand, fine in texture and high in silica.

The sand is sprinkled or shaken over the face of the mold, a certain amount adhering to the surface of the mold while the excess is blown off.

An analysis of parting sand is of little use, as the molder knows more about it than any chemist or outsider.

"Mill Dust" is sometimes used in place of parting sand and the novel feature introduced in a certain malleable iron foundry noted for smooth finished castings designed for harness trimmings, etc., is worthy of note.

A pail of "mill dust" i. e. dust from the tumbling barrels, is mixed with a little crude oil (fuel oil) and set afire.

The fire burns out the oil and leaves a fine coating of carbon on the sand, giving it the appearance of plumbago.

Mill dust treated in this way makes an excellent parting material and is well adapted to the "shake bag."

Charcoal is another substance used for parting and is very satisfactory, but not used so extensively of late as in former times.

The two analyses, No. 10 give sufficient data to enable one to judge of its composition in comparison with coal, coke, etc.

Charcoal may be made from nearly any kind of wood by burning without access to the air; charcoal for medicinal purposes is generally made from willow or birch; charcoal for smelting purposes is made from oak, hemlock, pine, ash or other wood growing in the vicinity of the mines.

Certain kinds of wood produce a soft, porous grade of charcoal, while others give a firm, hard product; as a rule the firm or dense kinds of wood produce the hardest charcoal.

The temperature and time consumed in carbonizing are important features; a low temperature continued for an extended time will produce a better grade of charcoal than a high temperature of short duration.

Charcoal may be made at a temperature ranging from 500° to 2,700° Fahr. but the ordinary heat is between 480° and 810° Fahr.

The density of charcoal obtained between the temperatures 302° and 518° Fahr. decreases in gravity from 1.507 to 1.402.

On the contrary, that which is afforded between 518° and 662° F. increases from 1.402 to 1.500.

The most inflammable charcoals take fire at about 580° F. while those made at a high carbonizing temperature inflame at 680 to 800° F.

Charcoal is a great absorbent of gases and moisture, taking up many times its own volume of gas, and absorbing from 0.80 to 16.00 per cent. of water; beech absorbing the least moisture and black poplar the most.

Lycopodium is a light yellow colored powder used as a parting material for particular work in which it is desired to make a perfect separation of the two parts of the mold, especially in intricate or deep recessed patterns.

This peculiar powder is the fine dust obtained from the plant capsules, ***lycopodium clavatum***, commonly known as "club-moss."

It resists the action of water to such an extent that if the surface of a pail of water be sprinkled with the dust, the hand may be plunged into the liquid without wetting.

Owing to the high price of the powder it is often adulterated with one or more of the following substances:—the pollen of pine or fir, starch, dextrine, pulverized wax and soapstone.

The presence of pine or fir pollen may be detected by the microscope, the pine pollen being radically different in size and shape to that of the lycopodium sporules.

Lycopodium burns quickly when thrown into a flame, and on ignition leaves 4 per cent. of ash, the ash containing about 1 per cent. of phosphoric acid, the remainder being alumina, etc.

Any residue or ash in excess of 4 per cent. points to the presence of soapstone or other infusible matter and the determination of magnesia gives the amount of such adulteration.

Starch and dextrine are determined as follows:—moisten about half a gram of the powder with 5 c.c. of alcohol, add about 30 c.c. of water and boil for two or three minutes, then pour into a large beaker of cold water (about 500 c.c.), stir with a glass rod and when mixed, add about twenty drops of iodine solution (i. e. the iodine used for sulphur titration is the proper strength).

Starch gives a clear blue solution, dextrine a purple color, while lycopodium produces no color or at least only a faint yellow, due to the iodine.

Concluding Remarks.

Having explained the different methods for the detection of the different carbon compounds and adulterants used in foundry facings and parting material, it follows that:—the difference in volatile matter found by means of a proximate analysis distinguishes between hard and soft coal; the sulphur by absence points to charcoal or pure graphite; the water test detects coke dust, and the nitric acid test establishes the difference between graphite and all other carbons belonging to the coal family.

In making a proximate analysis and in de-

termination of sulphur, the same method should be used for all classes of material, consequently the "Eschka Method" for sulphur is to be preferred as it answers nicely for other material than coal.

Moisture is best determined on one gram of substance dried at 220° F. for an hour, cooled in a dessicator and weighed between clamped watch glasses.

For the determination of volatile matter and fixed carbon, Prof. Henrich's method is used, wherein the covered crucible containing one gram of substance is ignited over a Bunsen burner (Detroit pattern), for three and a half minutes, then over the blast lamp for three and a half minutes; the loss sustained representing the volatile matter.

The crucible cover is now removed and the crucible placed over a Bunsen burner and allowed to remain until the carbon is entirely consumed and nothing remains but ash.

When cool, the crucible and covers are again weighed and the difference between this weight and the previous weight after determination of volatile matter, is taken to represent fixed carbon.

The volatile matter added to fixed carbon and the result substracted from the original weight of the substance gives ash.

The following example will clearly illustrate the method, moisture and sulphur being determined on separate one gram samples.

Proximate Analysis of Soft Coal.

Weight of crucible and cover	=	24.2490	grams
Coal added	=	1.	"
		25.2490	
After 3½ min. over burner and 3½ min. over blast lamp	=	24.8708	"
Volatile matter (Loss)	=	.3782	"
Weight after determination of Volatile Matter	=	24.8708	"
Weight after burning to ash	=	24.3137	"
Fixed Carbon (Loss)	=	.5571	"

Volatile Matter .3782 plus .5571 = .9353 gram .9353 subtracted from original weight of substance — 1. gram = .0647 gram of ash.

Multiplying by 100. for per cent., we have the following:

Volatile Matter	=	37.82	per cent.
Fixed Carbon	=	55.71	" "
Ash	=	6.47	" "

The hygroscopic water (moisture) determined on a separate gram sample was .0053 gram, therefore this must be substracted from the volatile matter if the moisture is to be represented in the analysis.

Sulphur determined on a separate one gram sample was found to be 0.80 per cent., and may be stated as a separate quantity or included in the analysis by subtracting half from the volatile matter and half from fixed carbon.

In the first event, with sulphur as a separate quantity, the analysis would be stated as follows:

Moisture	=	.53	per cent.
Volatile Matter	=	37.29	" "
Fixed Carbon	=	55.71	" "
Ash	=	6.47	" "
		100.	

Sulphur = 0.80 per cent.

With sulphur interpolated in the analysis the statement would be:

Moisture	=	.53	per cent.
Volatile Matter	=	36.89	" "
Fixed Carbon	=	55.31	" "
Sulphur	=	.80	" "
Ash	=	6.47	" "
		100.	

FOUNDRY FACINGS.

BY E. D. FROHMAN, PITTSBURG, PA.

The manufacture of foundry facings has always been looked upon by the foundrymen as a mysterious business. Facings were supposed to have caused such of the castings that were bad. A scab, a buckle, a non-vented mold, and, in fact, any old thing was charged to the facing. The temperament of the molder, that is, the man behind the guns, was not taken into consideration. Thanks to science, we are seeing daylight, and a study is being made of the facings, blackings, sands and binders used in the foundry. It is almost laughable at times to go into a foundry and hear a foreman or proprietor say, "Now, don't ship one barrel of good blacking and then commence to dope the goods." Oh! if these gentlemen only knew that it is a very special aim to keep goods alike. A remark of this kind would sound queer when applied to castings. All the resources of science that man can command are used to have one barrel of facings turn out like the other. Now, let us look at the manufacture, the composition of various materials, and we will see where chance of variation comes in, where the manufacturer must use his skill and where the foundrymen must help.

Plumbago is a mineral found in various parts of the world in two forms—flake or crystaline, and amorphous or globular, at is were. It is a form of carbon, the same as coal or coke, but purer, that is, if the plumbago or graphite is free from external matter. We often have our chemist analyze plumbago, and the result shows 60 percent carbon and the balance ash. At once one would say, "The plumbago is not pure but adulterated." This is not directly true, especially if it is Ceylon or East India quality or any flake plumbago. It is unadulterated as far as Mother Earth is concerned, but not *refined.*

Flake plumbago is most refractory and will stand more heat than any form of carbon, excepting the diamond. The scales or flakes are cemented together in nature by a silicate of iron, and to make the finest foundry facings and highest quality of flake graphite—so-called lubricating plumbago—this silicate of iron is removed. In manufacturing the best foundry plumbago, this silicate of iron is removed and an amorphous plumbago substituted. When this is thoroughly done we have the best material for foundry facing that has as yet been produced. The silicate of iron or dust, as it is sometimes called, is removed mechanically; no chemical method has as yet been discovered which is economical.

A refined East India plumbago makes an exceptionally fine grade of facing for high class work, where care can be used to place it on the mold, but, as founders are aware, more goes on the sand heaps than on a mold, or, in other words, is wasted, and hence the purchasing department says, "a cheaper grade must answer the purpose." This cheaper grade is usually a ground plumbago and not refined. Plumbago can not be sold cheap, which is quite clear to anyone manipulating machinery. The removal of the dirt and the method of mining are in a great way responsible for the saying, "Don't give us one good barrel and then let the quality go down." In manufacturing this material, 250 casks are made at a time in order to prevent, if possible, any change in the batch, because the larger the amount made the less the chance of error.

Having stated that the method of refining is mechanical, the mining factor must be discussed. Most of the graphites come from the Island of Ceylon. These mines vary exactly as do certain mines in the coal regions of this country. In selecting graphites, chemical analyses and pyrometric tests are used. The analyses of the ash of the various graphites aid in determining whether the goods are suited for foundry facings, for crucibles, or for another purpose. For certain kinds of work an amorphous graphite will work and will give good results, but we often hear that it is too sticky and won't slick. This is due to shape of the particles of the material. While this may be higher in carbon it has not the heat resisting qualities of Ceylon or crystaline graphite and has not as yet been used in the successful manufacture of crucibles.

As stated before, in the manufacture of highest grade foundry facings, the dirt is removed and an amorphous graphite added to the refined plumbago. This is to give the facing body.

Next in importance to plumbagos are coke blackings, and I am candid in saying that there is more cause of worry to the facing man than the plumbago, for we have even had seventy-two hour coke burned especially for us and had kicks therefrom. We have used forty-eight hour coke and had partial success. We are satisfied that for certain work a soft coke must be used and for other work a hard coke, but why, I am free to confess, we know not. We candidly believe that the facing man of the morrow will have to know the composition of sands used, and in this way determine what is best adapted for certain work.

The coke problem for the facing man is as serious a problem as pig iron to the foundrymen. In the last twenty-five years the foundrymen have found out that the exact compositions of their irons and how the various impurities affect them. The facing men are now studying the various forms of coke and finding out exactly what is needed to make good blackings and are delivering better goods than were delivered ten years ago.

The problem of soapstone and the other facings used have been discussed many times and nothing of interest and new can be said of them. It stands to reason that the highest quality of goods are required to do the best work.

FOUNDRY COSTS.

BY ELLSWORTH M. TAYLOR, BOSTON, MASS.

Costs; the pulse of your business, indicating absolutely the trend of your business vitality.

During the past decade the business methods of manufacturing and producing plants have been entirely revolutionized by the introduction of modern ideas, while the foundry has until recently been practically neglected.

Manufacturers have been brought to realize

that they cannot get the full benefit of the introduction of improved mechanical appliances without knowing unmistakably the actual effect these appliances have on the cost of the product.

The old method of estimating selling prices by guessing at the original cost has rapidly been discarded, and facts hitherto allowed to remain in the head or heads of one or two or three employes, as the case may be, have been transferred to positive records, and constitute a tremendously valuable working asset of the business.

A man must die, but the experience of years must live to assist the next generation in bringing the business to the highest state of perfection, without being compelled to travel over the old ground again.

In other words, this is an age of industrial progress and men cannot afford to waste time in solving problems which have once been met and mastered.

The modern business man is practical, if nothing else, and he knows that to conduct his affairs successfully he must have cold hard facts. He measures every step by the dollar rule.

The properly regulated, modern cost system is the relentless eye constantly examining and scrutinizing every nook and corner of your business, calling your attention automatically to leakages and excessive expenditures, substantiating or disproving whatever information may have come to you verbally or by observation, enabling you immediately to use all your energy and brains to cure the sore.

"Why is it," asks the manufacturer, "that we only show a profit this year of 12 percent as against 20 percent one year ago? We have been operating under practically the same conditions and have figured our selling prices in the same way."

There is evidently a serious error in your costs. Your direct labor on certain jobs has greatly exceeded your estimate, the amount of your burden or unseen dollars has exceeded your expectations; your orders have actually happened to run to that class of goods which you are regularly selling at a loss because you have no accurate method showing what your actual burden or unseen dollars amount to, and your method of applying an inaccurate burden to your first cost to establish your selling price is radically wrong.

Your crude method of using your pay roll and material expenditures gives you no proper line on your leakages, your personal observation and verbal reports deceive you as to true conditions, and leakages which you should measure in dollars and cents at least once a month, you allow to go undiscovered until the end of a fiscal year, when it is too late.

You are making a gambling proposition out of a legitimate industrial business.

You carry an insurance policy on your life, you protect your property against loss by fire, but you are not carrying a cost policy drawn up on lines which protect the most vital part of your business.

To illustrate how easy it is for the foundry man to fool himself in regard to his costs, one example will suffice.

Some capitalists were considering the advisability of investing one hundred and fifty thousand dollars in cash in an established business including a foundry and machine shop.

The statement had been made that the iron castings were costing at an average not more than one dollar and sixty-seven cents a hundred pounds.

I was delegated to visit the plant and conduct a general investigation. In order to test the accuracy of the foundry costs, I selected a month in which it was claimed the cost was one dollar and seventy-seven cents per hundred pounds.

On examining the cost method I found that several important points had not been taken into consideration. I drew up the data in the proper manner, supplied the missing links, and the actual cost of the castings was found to be two dollars and thirteen cents per one hundred pounds, and not one dollar and seventy-seven cents.

Part of the product of this foundry was sold to the machine shop and figured in the machine shop costs at two dollars per one hundred pounds, and the balance was sold to the trade at an average of about the same amount.

Thus this foundry was actually losing money at the rate of thirteen cents per one hundred pounds instead of gaining twenty-three cents as shown by their cost report.

The existence of this leakage was a great surprise to the officers of the company and they immediately acknowledged the inaccuracy and weakness of their cost method.

Of how much value is this kind of information to the foundry man?

It may mean the very life of his business.

Accurate cost methods are of equal value to the small and large foundry and the general scheme of foundry costs is the same whether

you are operating a jobbing foundry or a foundry in connection with a machine shop.

As a matter of fact, the machine shop foundry must be considered in the light of a jobbing foundry. That is, the treasurer of the company agrees to buy the entire output of the foundry for a certain period at certain fixed prices, and the foundry must produce good castings at a cost sufficiently less than the market offers to warrant the treasurer in setting the foundry up in business.

If the foundry cannot do this, it would be to the advantage of the business to close the foundry and buy the castings outside.

And the treasurer cannot afford to fool himself as to the actual conditions.

He will have installed a monthly cost report, divided into three general sections: Metals melted, producing labor, expense.

The monthly postings to these sections will be made up as follows:

Materials.

In every foundry there are certain materials which are purchased from hand to mouth; that is, in quantities which are practically used up from month to month. Materials of this kind are usually miscellaneous supplies, such as molasses, facing, flour, small hardware, etc.

From the cost and accounting standpoint it is best for every foundry to draw up a list of all materials of this nature and as soon as the invoices covering these materials are received and O. K'd, the face value of the invoices should be immediately charged off into the proper subdivision of the expense section of the foundry cost operations for that period.

At the end of each month the accumulated totals of these items will be posted to the monthly cost sheet.

Invoices covering heavy materials, such as the different kinds of metals, coal, coke, sand, lumber, etc., should be charged into a general foundry stores account, and a stock ledger account in card form should be kept of each different kind.

These ledger cards will be debited in the first place with an inventory of the quantity on hand, and thereafter with the quantities as they are received.

A daily melt record must be kept showing in detail and by actual weight the quantities of the different kinds of materials which have passed over the cupola floor.

This daily record must pass promptly to the cost department and the quantities shown must be posted to the credit side of the ledger card covering that particular material.

In the case of all heavy materials which do not pass over the cupola floor, methods must be provided for daily records of quantities used. Take sand, for example. Pads should be nailed up in a convenient place in the path of the employe whose business it is to transport the sand from the sand bins into the foundry proper. Each time a load of sand is carried in a mark must be made on the pad. The capacity of the wheel-barrow or other conveyance is known and the quantities used may thus be easily obtained.

These records must also be transmitted to the cost department and corresponding entries made on the ledger cards.

The ledger accounts must be closed each month, and the quantities of *metals* used will constitute the gross melt for the month under the "Metals Melted" section of the cost sheet.

The quantities used of all other heavy materials will be carried into the proper subdivision of the *"Expense"* section of the cost sheet.

These card ledger accounts must be periodically checked up with the actual quantities on hand, and thus constitute one check on the accuracy of the daily reports.

In brass foundries particularly the importance of this close check on materials cannot be over-estimated.

Labor.

The pay roll must be divided into two general classes, productive and non-productive.

From a cost keeping standpoint, productive labor includes only such labor as is capable of being charged direct to a certain casting or job.

The importance of distinguishing productive labor must be emphasized, because in analyzing your costs the productive hour or the productive dollar is the acknowledged unit of distribution for all foundry expense or burden dollars.

Labor of this kind will be made up principally from the money paid to molders, but in some cases will include helpers and core makers.

Non-productive labor is all labor, including clerical work which for any reason whatever is incapable of being charged to a particular casting or job.

There are in every foundry a certain number of general utility men who are really direct producers, but who spend only two or three minutes consecutively on any particular casting or job.

From a clerical and practical standpoint it is not often feasible to attempt to charge two or three minutes to a certain casting, and for this reason all such work must be classed as non-productive and included in the proper subdivision of the expense section of the cost sheet.

Expense.

In addition to the material and labor distribution to the expense section, there must be charged in each month a fixed sum which is one-twelfth of the total amount of private pay roll, insurance, taxes, interest, depreciation, and all other items incapable of direct distribution.

The cost sheet is then ready for certain final postings which must come from the monthly production sheet described below:

Production.

A daily record must be kept which will give:

First—The gross quantity of salable castings produced.

Second—The gross quantity of foundry tools and temporary equipment produced.

Third—The gross quantity of bad castings returned from machine shop or customers.

Fourth—The gross quantity of bad castings detected in foundry.

Fifth—The gross quantity of gates, sprues, runners, etc., made.

The accumulated totals of these items posted to the proper divisions of the monthly production sheet give the gross pounds which can be accounted for out of the metals melted and the pounds lost in melting.

The totals of items two, three, four and five must then be credited to the cost sheet record of gross melt, and in this way an amount is developed showing the net number of pounds actually used to produce the net quantity of salable castings.

Reducing these weights to dollars and cents and combining with labor and expense data on cost sheet gives you the cost of your product, and your loss or gain.

If the production sheet is properly designed, it will establish beyond doubt the reason for any fluctuation in cost one month as against another.

This method of working the cost down from gross metals melted to net quantities and values is an absolute check against serious error, whether clerical or physical.

For instance, suppose the figures show a greater quantity of salable castings produced than pounds of net material used. Or suppose a loss in melt is developed of more than 7 percent? In the first case, if the error is merely physical, your costs are seriously affected. Or, if you are operating on a piecework basis, you may have paid for more castings than have actually been produced.

In the second case the error may be physical, or there may be serious trouble with your cupola. In either case the subject requires careful consideration and investigation.

A close scrutiny of all the facts set forth on these monthly reports will likewise give the foundryman a line on the actual efficiency and condition of the entire foundry.

Analyzing Costs.

In the large iron foundry comprising green sand, dry sand, loam and machine departments, it is necessary that the daily reports and records provide for a distribution of labor, castings produced and castings lost by departments.

In the jobbing foundry it is important to know the relative value of each customer's business.

To establish these facts it is necessary to accumulate the total number of productive hours or the total productive labor value expended on all work for the customer during a given period.

The cost of the net material used per pound is shown by the monthly cost sheet, as is also the hourly or percentage rate of expense.

These units may be readily converted into total dollar expenditures, giving the entire cost of the product up to your shipping office door.

To know the cost of particular castings or any class of castings the foundry man must have a record of the actual productive labor, in hours or money, expended on the castings. With this fact established the total cost is figured in the same manner as outlined in the previous paragraph.

In brass foundry work the cost of the net material used will vary according to the value of the different mixtures; otherwise, the general method of figuring is the same as outlined above.

Foundry Orders.

The foundry order system should be so designed that the initial entry will by one writ-

ing: (1) constitute the permanent office record; (2) advise the pattern shop to prepare the patterns and deliver them to a certain molder; (3) advise the core shop of the number of cores required and to whom to deliver them; (4) authorize the molder to proceed with the work, tell him when delivery is required, and provide him with a place to record the number of good and bad castings which he produces; (5) give complete shipping instructions to the shipper; (6) act as a tracer notifying the office of

(1) The date of delivery of pattern to foundry;

(2) Molder to whom work has been assigned;

(3) Date of final delivery of cores;

(4) Date of completion of order by molder;

(5) Final date of shipment.

The foundry manager is in this way at all times in touch with every order which has been issued, and can answer inquiries with the least possible delay.

A system of this kind is so elastic that it permits each foundry manager to arrange it to cover conditions which may be peculiar to his foundry alone. Furthermore, the order system is closely allied to the method of analyzing costs, and warrants careful thought and attention.

Patterns.

Every foundry manager realizes the importance of a quick handling of patterns.

To facilitate this work all patterns received by the foundry should be catalogued, preferably in card form.

The catalogue should give a complete description of the patterns and the core boxes, stating the number of pieces in each.

The pattern storage loft should be divided into sections, bins and shelves, and numbered or lettered. On the receipt of a pattern it should be assigned to a permanent resting place in the storage loft, and letters or numbers indicating the location should be marked on each part of the pattern. At the same time the location is entered on the catalogue card.

In many foundries today there is an annual leakage of a great many dollars because of the crude and unsystematic manner of handling patterns. Lack of system here places the foundry at the mercy of one or two men who may happen to remember that such and such a pattern was originally stored in a certain section. Shipments are many times delayed and errors are invited, with a consequent feeling of annoyance and irritation reaching from the manager to the shipper.

Again, what will be the loss to the foundry, measured in dollars and cents, if the foundry should be deprived of the services of the man who carries the information in his head?

With the patterns properly marked and catalogued, the pattern storage loft becomes an automatic machine which may be operated by any employe who can read numbers and letters.

Inspection.

Valuable information will be obtained from the proper record of bad castings. It is always to the advantage of the manager to have a positive record of the relative value of his workmen. This information comes primarily from the inspector or from the employe acting in that capacity.

For this purpose "Castings Rejected" slips are issued by the inspector for each casting lost. These slips authorize the workman to reproduce the castings when necessary, act as a notification to the office to deduct the amount from the workman's pay, if the work is piece work, and finally are so treated in the office that a true record of the value of the workman is obtained.

In times of business depression or internal trouble and discontent, these individual records may be effectively used by the management.

The Chemist.

The importance of a periodical chemical analysis of the metals melted and the product obtained is now so thoroughly recognized that it hardly necessary to discuss the subject.

The chemist not only keeps the foundryman from getting into trouble in his mixtures, but reduces the costs by recommending that a greater percentage of scrap may be put into the mixture because the metal people occasionally ship materials of more potent chemical properties than called for in your order.

Statistics.

The cost department should prepare a set of statistics so arranged that the most important points of the cost and production sheets may be compared from month to month in deadly parallel columns.

These statistics should cover the entire fiscal year on one form, and in addition to data of cost, etc., should record ratio of coal and coke to metals melted, average number of producers and non-producers, average number of days

worked, and all other data of importance to the management.

Organization.

This subject may be described briefly as the centralization of all work and the authority to do work immediately under the eye of the management.

The management must run the business, or the business will run the management.

General Remarks.

This paper is designed to cover in a general way the vital points which have to do with any and all foundries.

In the actual installation and operation of a system there are always local conditions which require individual treatment and consideration, but the skeleton or frame-work is identical in almost every case.

CORE SANDS.

BY J. S. ROBESON, CAMDEN, N. J.

Though it is far from my intention to exploit by advertisement before and through you the company with which I am connected, still some reference to it must, perforce, be made if a proper understanding of the few facts I am able to present is to be had.

For this reason I want you to know that this company has been engaged in the manufacture of a core sand binder for the past 12 years and, as this product forms the bulk of its output, naturally, a great deal of time and money has been spent in studying the question of binders; whether these had best be solid or liquid; made of dextrine, flour, rosin or oil, etc., etc.

Some of the tests made in this investigation, and what I believe to be the results proved by them, have already been published. As, for instance, when I had the honor of reading a paper before the Foundrymen's Association of Pittsburg on Feb. 6 last, attention was drawn to the fact that a liquid binder gives more satisfactory and economical results than a dry binder and others, I hope to bring to the attention of the workers in the art of founding as they develop.

When this work was commenced almost the first problem for which an answer was requested was, why the different core sand binders or compounds acted differently in different foundries, or more pertinently and personally why was not our binder a success in each and every shop?

This failure in one place and success in another is a fact that is true of every material used as a core sand binder, whether it be a proprietary article or not.

It is more marked—or perhaps it is better to say, more noticed—with the proprietary articles than it is with the three most commonly used materials, flour, oil and rosin.

What is the reason for this difference?

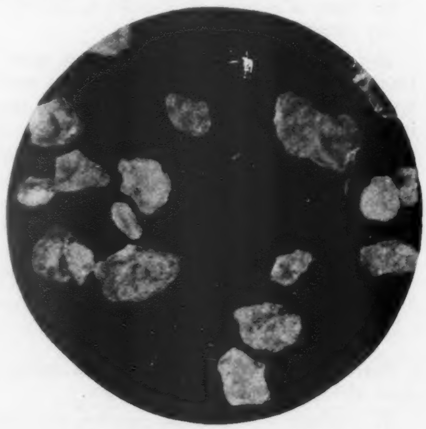
Foundries use for molding and core making purposes sand and loam.

Sand may be defined as water-worn disintegrated rock without plasticity or adhesiveness.

Clay as the remains of disintegrated rock that is both plastic and adhesive.

Loam as a mixture of clay and sand.

As none of these three are ever met with in a pure state in nature, so the variations in com-



NO. I. YELLOW SILICA SAND.

position are as great and uncountable as the sands of the sea.

It is almost within the bounds of the strict truth to say that every foundry uses its own particular sand or sand mixture for making cores.

Now, while sand is sand, so is food food, and yet I take it that you will agree that there is a very great difference between the lunch you have but just now enjoyed and the usual mid-day meal of the owners of this island before it was discovered by Tammany and famed by Columbia.

Just as great is the difference in the sands of your individual foundries.

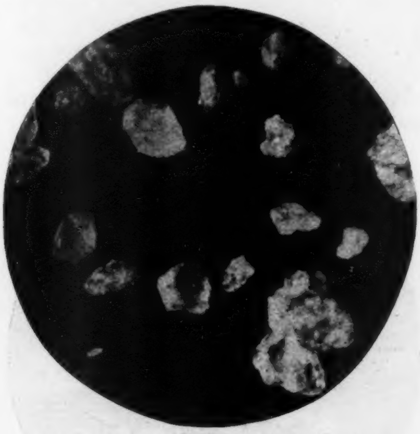
Sands vary in their chemical composition as to the amount of silica, alumina, iron, etc., that they contain and also as to the size of the grains.

This variation in the sand, not so much as

to the actual size of the grains as to the relative amounts of each sized grain present and the amount and kind of clay has more to do with the very dissimilar results obtained in making cores than has the binder.

The photomicrographs and the table of sieved results give a better idea than can be conveyed in words of the variations as to the size and proportions of the grains.

These photomicrographs are of sands that are commonly used in core making in different sections of the country.



NO. 2. DUNBAR SAND.

It is almost unnecessary to state that, although the pictures are of individual sands, the usual practice is to make mixtures of the different kinds in order to obtain the proper result.

Each sample has been enlarged to about the same extent, 1,600 times, so that some comparative idea may be had.

A very strong effort has been made to have the strength of these test cores comparatively equal. The same operator has made them, under the same conditions each time. They have been frequently checked and they are all made with one part of the same binder. Gluetrin, mixed with five parts of water to 50 parts of the sand. They are ⅞ in. round, made in a metal box, baked for the same length of time at the same temperature, supported on knife edges 8 in. apart for the breaking and the weight applied in the center.

In this connection it may be interesting to state that a core having a strength of one-half pound to the square inch is fully strong enough for any ordinary work.

1. Yellow Silica Sand: This makes the strongest core of any that have been tested, giving 6.47 pounds per square inch.

The proportions of the various sizes are such that the voids are well filled.

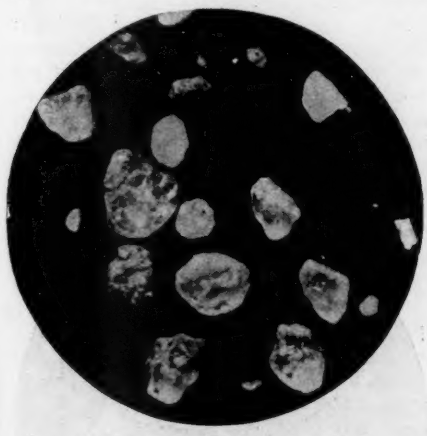
The clay is evidently also in about the proper amount, neither too much nor too little, for the one will weaken the core as well as the other.

A core made from the sand, washed free from clay, had a strength of only 0.27 pounds per square inch.

No. 2. Dunbar Silica Sand: This has a strength of 6.18 pounds per square inch, almost equaling No. 1 and, in the main, the proportions of the various sizes are about the same, but in this the percentage of the larger sizes is greater.

No. 3. Ithaca Glass Sand: This gives a strength of only 2.19 pounds per square inch. The proportions of the various sizes are different from No. 1 and No. 2 and there is less clay present.

No. 4. Welsh Mountain Crushed Rock: This gives a strength of 2.05 pounds per square inch, practically the same as No. 3. This is, however, a very different sand, inasmuch as it is



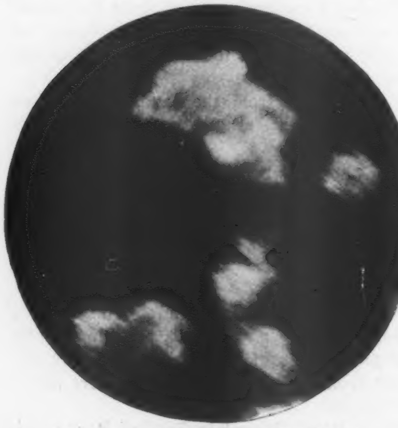
NO. 3. ITHICA GLASS SAND.

made by crushing a pure silica rock. This contains no clay and any binding qualities that it has in a core come from the proportions of the size of the grains and the binder.

No. 5. Burlington Island: This gives a strength of 2 pounds per square inch and it will be at once noticed that there are only three sized grains in this sand and that two of them are practically equal in amount. The binding quality of this sand comes largely from the clay contained in it. This clay or loam is attached

to and surrounds the grains of quartz in a different way than from any other of the loamy sands here shown.

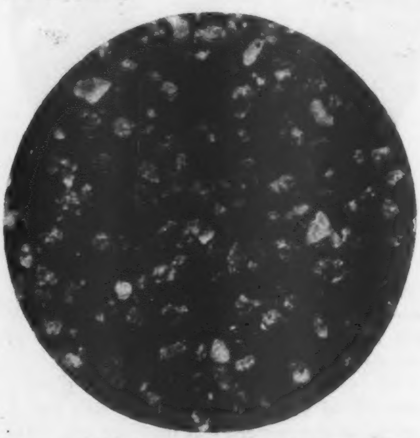
No. 6. Jersey Glass Sand: This gives a



NO. 5. BURLINGTON ISLAND SAND.

strength of 1.98 pounds per square inch and here we find practically only two sizes of grains and but little loam.

No. 7. Fine Molding Sand From Pittsburg: This gives a strength of 1.95 pounds per square inch, practically the same as No. 4, No. 5 and No. 6 and in this case there are again practically only two sizes of grains, but it will be noticed that the smallest size is present in a very much larger amount than in the sands just preceding.

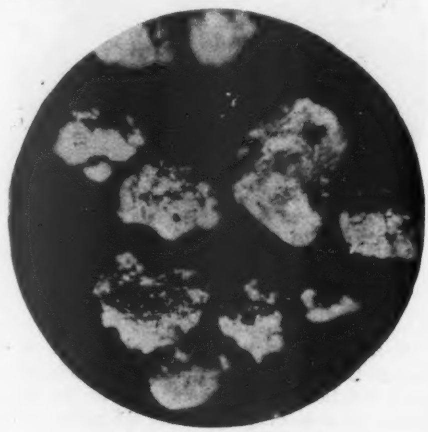


NO. 7. FINE MOLDING SAND FROM PITTSBURG.

No. 8. Allegheny Loam: This gives a strength of 1.83 pounds per square inch and here there are four different sizes of grains. The loam in this sand is of a very adhesive character, but there is too large a quantity present. If this sand is mixed with a sand that is free from loam, the core resulting from the combination shows a much greater strength.

No. 9 and No. 10. Latta Brook No. 1 and No. 2: These sands are from the same locality, have practically the same strength—1.68 and 1.65 pounds per square inch, but contain very different proportions of the various sized grains. No. 9 contains more loam than No. 10.

No. 11. Tullytown Sand: This gives a strength of 1.58 pounds per square inch and contains a considerable amount of loam, as well as a large percentage of the smallest sized grains.



NO. 8. ALLEGHENY LOAM.

No. 12. Albany Sand: This gives a strength of 1.46 pounds per square inch and it will be at once noticed that there is a large percentage of one size, the smallest, grain present.

No. 13. Ganister Rock: This gives a strength of 1.46 pounds per square inch and is a crushed silica rock, almost the same in chemical composition as No. 4. The proportions of the various sized grains are different, however, from No. 4, which accounts for its comparative weakness.

No. 14. Old Foundry Sand: This gives a strength of 1.25 pounds to the square inch. It is shown here more as a matter of curiosity than for any other reason, since this sand varies in every shop.

No. 15. Pittsburg River Sand: This gives a strength of 1.12 pounds to the square inch. This sand contains practically no loam; its

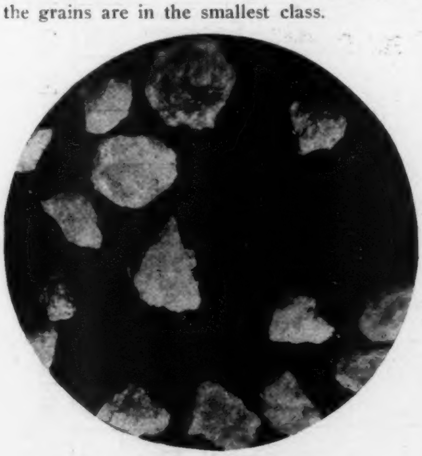
strength is entirely due to the proportion of the various sized grains.

No. 16. Millville Gravel: This gives a

NO. 12. ALBANY SAND.

strength of 1.09 pounds to the square inch and contains a very large amount of loam. The different sized grains are badly proportioned and the strength is largely due to the adhesive character of the loam.

No. 17. Providence Fine Core Sand: This gives a strength of 0.9 pounds per square inch and is a typical bank sand of New England. It contains a considerable amount of clay and it will be noticed that the greatest amount of the grains are in the smallest class.



NO. 13. CRUSHED GANISTER ROCK.

No. 18. Sodus Point: This gives a strength of 0.87 pounds per square inch and contains little or no clay. Such strength as it has is obtained largely from the fact that the bulk of it is composed of about equal proportions of the two smallest sizes, so that the voids are fairly well filled.

No. 19. Pittsburg Bank Sand: This gives a strength of 0.75 pounds to the square inch. This sand contains a great deal of loam and would evidently have a greater strength if there was a larger percentage of the finer sizes present.

No. 20. Lumberton Sand: This gives a strength of 0.71 pounds to the square inch and contains a large amount of loam. This sand has about the same strength of No. 19, but it will be noticed that it has a larger percentage of the smallest sized grains, and it might, therefore, be supposed that it would be stronger.

NO. 14. OLD FOUNDRY SAND.

The grains, however, in this sand are all rounded, whilst those of No. 19 are decidedly angular. This comparison as to the shape of the grains also applies to No. 16.

No. 21. Pennbryn White Silica: This gives a strength of 0.56 pounds to the square inch and contains practically no clay or loam, it being a washed sand. The proportions of the three sized grains present are bad, which accounts for its comparative weakness.

No. 22. Rockaway Beach: This gives the same strength per square inch as No. 21 and the same remarks are true concerning it.

No. 23. Scranton Sand: This gives a strength of 0.56 pounds to the square inch. It contains little loam or clay and would be a very much stronger sand were it not for the fact that the proportion of large sized grains is too great.

In the table is shown the amounts, graphically and in percentages, of the different sized

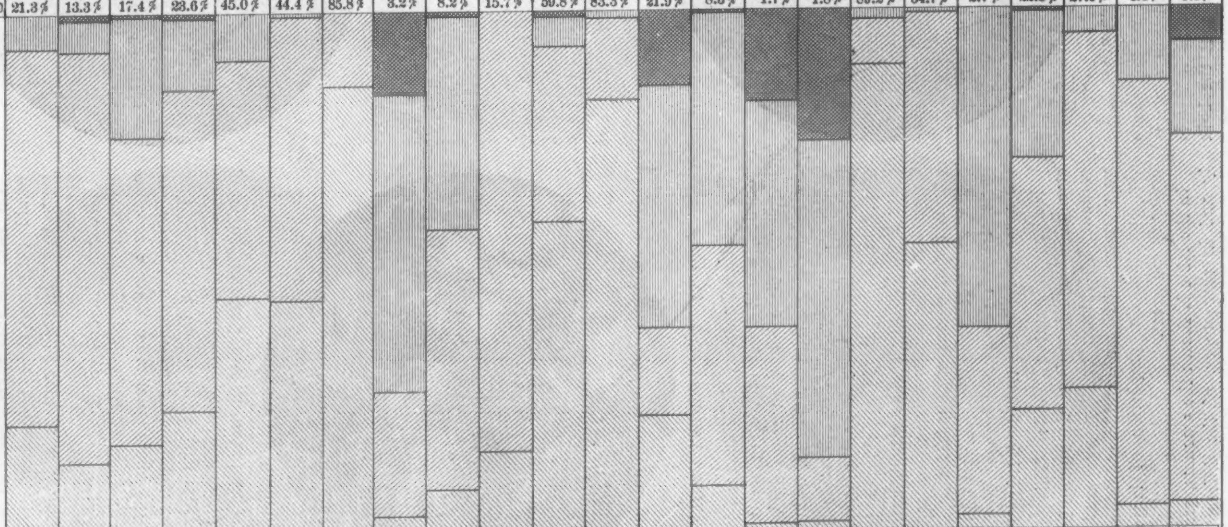
SIEVE ANALYSIS OF SANDS AND TENSILE STRENGTH OF CORES MADE WITH GLUETRIN.

No. of Sieves used	#1 Yellow Silica	#2 Dunbar	#3 Ithaca Glass	#4 Welsh Mt. Crushed Rock	#5 Burlington Island	#6 New Jersey Glass	#7 Fine Moulding Sand Pittsburg	#8 Alleghany Loam	#9 Latta Brook #1	#10 Latta Brook #2	#11 Tully Town	#12 Albany
#2, #4,	0.00%	1.10%	0.4%	0.7%	0.00%	0.00%	0.00%	15.8%	0.40%	0.00%	0.6%	0.00%
#8, #16, #20	6.9%	5.9%	23.4%	14.3%	9.3%	0.10%	0.00%	57.3%	41.5%	1.5%	5.7%	1.0%
#40, #60, #80	71.8%	79.7%	58.8%	61.4%	45.7%	55.5%	14.2%	23.7%	49.9%	82.8%	33.9%	15.7%
#100, #150, #200	21.3%	13.3%	17.4%	23.6%	45.0%	44.4%	85.8%	3.2%	8.2%	15.7%	59.8%	83.3%
Tensile strength in pounds sq. inch	6.47	6.18	2.19	2.02	2.00	1.98	1.95	1.83	1.68	1.65	1.58	1.46

No. of Sieves used	#13 Crushed Ganister Rock	#14 Old Foundry	#15 Pittsburg River	#16 Millville Gravel	#17 Providence Fine Core Sand	#18 Sodus Point	#19 Pittsburg Bank	#20 Lumberton	#21 Penn-bryon White Silica	#22 Rockaway Beach	#23 Scranton
#2, #4,	14.5%	0.1%	17.4%	25.5%	0.00%	0.00%	0.00%	0.3%	0.00%	0.00%	6.6%
#8, #16, #20	46.5%	45.3%	44.3%	60.6%	1.8%	0.3%	61.1%	28.4%	4.9%	14.1%	18.4%
#40, #60, #80	17.1%	46.3%	36.6%	12.1%	9.0%	45.0%	36.2%	48.5%	68.1%	81.6%	69.9%
#100, #150, #200	21.9%	8.3%	1.7%	1.8%	89.2%	54.7%	2.7%	22.8%	27.0%	4.3%	5.1%
Tensile strength in pounds sq. inch	1.46	1.25	1.12	1.09	0.90	0.87	0.75	0.71	0.56	0.56	0.56

Largest diameter of grains passing through Sieves in fractions of an inch.

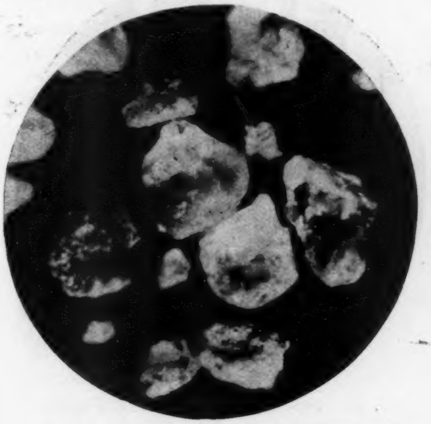
#2 — 0.435″ #16 — 0.0417″ #60 — 0.009016″ #150 — 0.003″
#4 — 0.201″ #20 — 0.0335″ #80 — 0.00675″ #200 — 0.002″
#8 — 0.0955″ #40 — 0.01475″ #100 — 0.0055″



The Foundry

grains in each of these twenty-three sands.

From the figures as to strength given in the table it is evident that any single one of these sands will make a core that is strong enough to do the work.



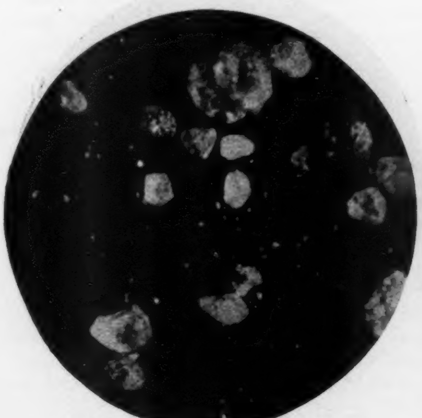
NO. 15. PITTSBURG RIVER SAND.

There are, however, other points to be considered besides mere strength in a core.

Following the requirements as set down for a good binder in the Pittsburg article of Feb. 6, 1905, a good core

No. 1.—Must be strong both green and dry.

No. 2.—Must be weak and rotten after the casting is cooled.



NO. 16. MILLVILLE GRAVEL.

No. 3.—Must not be easily affected by moisture.

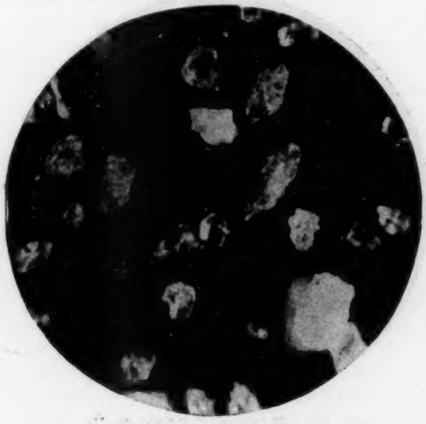
No. 4.—Must give off but little gas.

No. 5.—Must dry quickly.

No. 6.—Must not change in size.

No. 7—Must have a low cost.

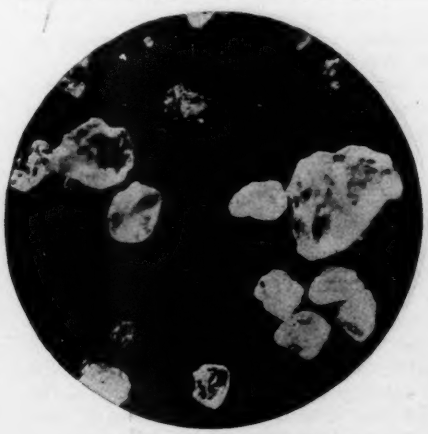
Now cores made of a single sand, in most cases, will not give the best results under all of these heads.



NO. 17. PROVIDENCE FINE CORE SAND.

If, for instance, a sand is too low in clay a larger amount of the binder must be used to give the necessary strength and this, perhaps, will be too great a quantity to burn out during the pouring of the metal so that the core will not be weak but hard and difficult to remove from the casting.

Likewise the binder in such a core will cost entirely too much per ton of sand mixed.



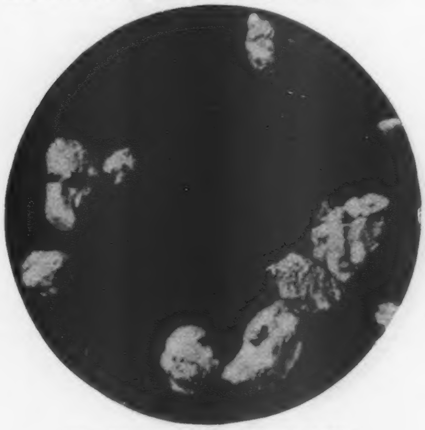
NO. 18. SODUS POINT SAND.

In such a case a mixture of sand must be made so as to add loam or clay and the amount of binder reduced.

On the other hand, if the sand contains too

much clay, only a small amount of binder will be required, but the core may be like a brick and so dense and compact as to blow.

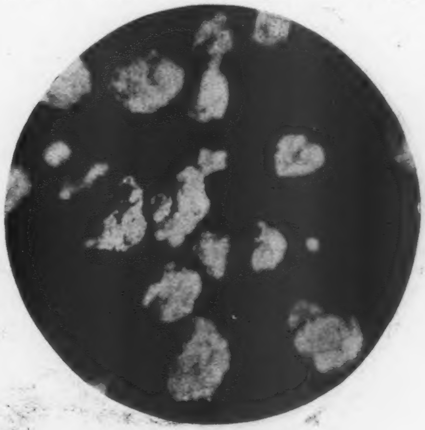
In such a case add a sand containing less clay and increase the amount of binder.



NO 19. PITTSBURG BANK SAND.

This sounds, in a way, as very simple, but when you recollect that the size and proportions of the various sized grains have much to do with the question, as well as the clay, it is no wonder that the coremaker is often puzzled over his sand mixtures or dislikes to change them once they be established to his satisfaction.

As the binders act in a different way, there is here another variable brought into the story.



NO. 20. LUMBERTON SAND.

Flour swells and pushes its way between the grains, but does not move from the place where it was left in the mass by the mixing and ramming.

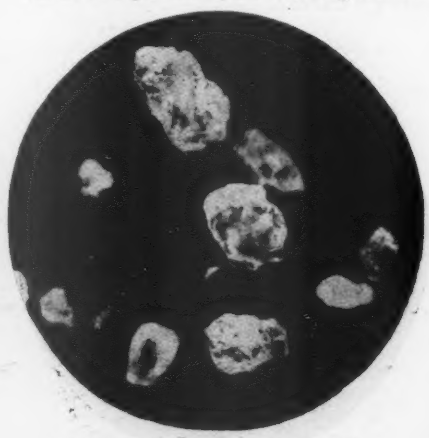
Rosin, under the influence of the heat of the core oven, melts and runs somewhat through the mass, though a large part of the original grain remains in the last position of rest.

NO. 21. PENNBRYN WHITE SILICA SAND.

Oil and gluetrin, because they are liquid, spread more evenly throughout the mass and over each grain during the mixing than do the solids, and when the heat is applied thin and spread still further.

Thus the sand mixture may often have to be changed when the binder is changed if the best results are to be obtained.

As an example of this, the following mixture



NO. 22. ROCKAWAY BEACH SAND.

worked fairly well, though with occasional trouble from blowing:

2 parts loamy sand
1 part sharp sand
Flour, 1.15.

Gluetrin at 1-50 was tried as a substitute for the flour, mainly because it was claimed that it would not blow. The cores did, however, both blow and scab.

The sand mixture was changed and successful results are now obtained from this:

1 part loamy sand.

1 part sharp sand.

Gluetrin mixed with 2 parts of water, at 1-70.

This likewise reduced the cost of the binder per ton very considerably.

In another case, a foundry making small cores used the following:

5 buckets burnt cores.
42 " gangway sand or sweepings.
8 " coarse sharp sand.
10 " fine Albany sand.
½ " Gluetrin, mixed in 5 buckets water.

This is 1 part of binder to 30 parts of sand and they claimed that the cores were difficult to clean from the castings.

It was suggested that they try the following mixture:

5 buckets burnt cores.
52 " gangway sand or sweepings.
8 " coarse sharp sand.
½ " Gluetrin, mixed with 5 buckets water.

With this they had uniformly successful results.

The trouble had been laid at the door of the binder and if they had not been willing to make this change in their sands another would have been added to the already long column of mysterious failures.

The binder would have once more been blamed for the fault of the sand and an opportunity to save money both on the sand and the binder lost.

ALUMINO-THERMICS.

BY W. M. CARR, NEW YORK.

It is a new idea to offer a metal as a fuel. To the minds of most of you, when thinking of the manufacture of pig iron, there is always the suggestion of the metalloid carbon as a fuel or source of heat when oxides or ores of iron are to be converted into iron as it commonly appears. In presenting the following remarks and experiments, there is introduced to your notice the striking effect of aluminum, when associated with metallic oxides under certain conditions, displaying phenomena similar to carbon. This difference will be noticed, however, that no appliances are required beyond a simple melting-pot or crucible in which to conduct the reducing or converting operation for treatment of the oxides. This process requires no cumbersome apparatus, and for speed and simplicity stands unexcelled. Neither is any power necessary, as in the case of an electrical equipment, and the heavy cost of installation for the separation of metals in that interesting development known as electro-metallurgy. The principle involved rests on the strong affinity of aluminum for oxygen when brought to a high temperature. This action does not depend entirely upon atmospheric oxygen, certain metallic oxides being brought into intimate contact with aluminum and the necessary oxygen taken from them. Such a mixture is called a thermit. Putting it another way, a thermit is an intimate mixture of certain metallic oxides and aluminum; each in certain degrees of fineness and compounded according to methods developed by extensive research and experiment, which when ignited will continue by chemical action to transfer the oxygen from the given oxide to the aluminum, producing in this way very desirable results.

To produce certain metals quickly and economically by Dr. Hans Goldschmidt's process, recourse is had to the above mentioned property of aluminum as a fuel or producer of heat instead of carbon, and, if desired, use can be readily obtained of the extremely high and sudden temperature resulting from the metallic fuel or heating agent. In certain combinations, the heat generated by the burning of a thermit is very great. Careful calculations show the temperature evolved to be very near that of the electric arc. It is said to be 5,400 degrees F. or 3,000 degrees C. The intensity of the glare is offered as a simple evidence of that fact. The density and volume of the heat is also very great, and since the generation of heat is undiluted by atmospheric conditions, as in the case of burning carbon, which requires large quantities of air for its combustion, we have an available supply of heat not to be approached by any other known simple means. The adaptability and flexibility of Dr. Goldschmidt's invention is embodied in the simple fact that a thermit will react when heated locally by some agent producing a high temperature. There is no need to supply extraneous heat to the compound beyond that offered by a blow-pipe. In practical operations, there is used a primer or ignition powder which when lighted communicates its heat to the ther-

mit and extends throughout the mass, and in a few moments the whole is liquid and glowing hot. As a product of the combustion of the aluminum, we have a regulus of metal superimposed by a sharply defined layer of slag. The slag is fused emery or alumna, and commercially is designated "Corubin" (Registered Trade Mark).

I will now show you how a thermit is ignited and when fusion is complete, occupying about 15 seconds, make a separation by decantation of the slag which is above and the metal coming last from below. As an evidence of the extremely high temperature, I will perform another experiment and will allow the stream of liquid thermit metal, steel in this case, to flow upon and pass through a piece of 1-in. boiler plate placed in a slanting position below the crucible. Please note the speed with which the hole is bored, and also the fact that it is possible to hold the plate in the hand immediately after the steel passes through. These experiments will convey to your thought the immense possibilities of the thermit process. No exaggeration is made in the statement that the temperature generated is twice as high as any pig iron when tapped from a cupola or any similar melting furnace. It is nearly twice as hot as steel produced by the open-hearth process.

Commercially stated, the thermit process is divided into two classes: First, thermits for heating and welding purposes; second, thermits for the separation of rare metals of great purity in composition, notably, being free from carbon. We will consider some of the practical phases of those of the first class.

The thermit for heating and welding consists of a proper mixture of aluminum and iron oxide. When ignited, as shown in the foregoing experiments, we have instantly available a supply of intensely heated slag and metal, a mild steel, for a variety of practical and useful purposes. For certain applications the fluidity of the slag can be regulated. That is, it can be produced very liquid or semi-plastic. The thermits with the thicker slag are used as heating agents for brazing or annealing, namely, copper fittings and spots in armor plate.

I will now show you how the heat of an action resulting from the burning of the ordinary heating and welding thermit can be applied to the welding of light sections, such as tubing. In this case perfect butt-welds are produced with the assistance of the fused slag and steel which, when cold, can be readily separated from the welding parts, leaving them clean and free from any adhering particles. Welds can be made on solid sections by casting around them the superheated steel in a manner not unlike the method of "burning" as followed in repairing gray iron castings, a plan you possess as regular practice. Thermit welds are made with a much smaller quantity, however, than would be needed in making welds or burning with ordinary liquid cast iron. In many cases repairs can be successfully conducted on gray iron castings by the thermit process. The points to be considered are, freedom of movement due to expansion and contraction, and the use of a liberal quantity of thermit steel to flow over the surfaces to be united. In the case of a fracture with both parts rigid, there may be difficulties by shrinkages, but with one or both parts free to move, that trouble can be avoided. It is but fair to say, however, that I have seen difficult welds successfully conducted on such parts as fractured spokes of cast iron locomotive driving wheel centers that gave excellent results in service. I have also seen welds on other cast iron parts, such as dies and anvil for stamping sheet metal, bolt heading machines, locomotive cylinders, large core arbors, etc. The process is completely successful in making welds on wrought iron and steel parts, such as shafting, steamship stern posts, locomotive frames, trolley rails, etc., and many defects or failures in steel castings are also readily remedied in daily practice by thermit. The points of interest in gray iron foundry practice that appeal to progressive foundrymen are the means of purifying cast iron, and the valuable adjunct in the high temperature and its great density available through the thermit process. Mention will be made further on of the purifying thermit. Attention will be given to the uses of the heat just mentioned, evidences of which you have seen in the experiments. Perhaps the greatest use of the heating and welding thermit is to revive the temperature of dull molten iron in any quantity. In large quantities of dull metal, the thermit is put into a can, in the bottom of which has just been placed about ½ oz. of ignition powder. The whole is attached to a rod and plunged below the surface of the dull metal. The reaction takes place almost immediately, giving off a large volume of heat which is distributed to the surrounding body of metal, and resulting in a considerable gain in temperature. In smaller quantities of metal, say, 1,000 pounds or less, the necessary amount of thermit to revive the temperature of such can be placed in a paper sack, not overlooking placing

the ignition powder in the bottom of the sack; then throwing the sack and contents upon the surface of the metal, a result similar to that described in the first instance can be obtained. Afterwards, a bar can be used to mix the treated metal thoroughly. The amount of thermit for such operations will vary from 1 percent to 5 percent of the contents of the ladle. In this way many castings can be poured that might otherwise be defective because of pouring "short" or "cold shuts." This method has been aptly termed "Foundryman's Accident Insurance."

Another proposition is to use thermit in large feeding risers or headers. It can be applied in different ways in sacks or cans. In each case when treating gray iron the ignition powder must be used. The object of putting thermit into risers is to get an increased fluidity and facilitate a good feeding effect. Such an application is very useful when the cupola is empty at the end of a day's work and no more hot metal is available to put into risers. The proper use of thermit in such cases will obviate shrinkage cavities in the castings often found below the risers. Thus the more important points of the heating and welding thermit are outlined. To any one once acquiring a little familiarity in handling it, almost endless uses will be suggested.

We have now come to the second division of the alumino-thermic process—that of producing with ease certain metals more or less refractory, among which can be mentioned chromium, manganese, vanadium, molybdenum, boron, copper, nickel, titanium, etc. These metals are used in many cases as ferro-alloys entering into other metals chiefly high-class tool steels.

In foundry practice the two thermits that are of special practical interest are the titanium and nickel. In introducing metals of a refractory character into molten pig iron, greater or less difficulties arise in melting and diffusing them in the liquid iron. It is not always practicable to charge them in the cupola. Breaking up into small lumps or even a pre-heating is not often easy. The ability to get a quantity of any metal, within the scope of the thermit process, in a few moments, is a decided boon to the founder. All that may be necessary is a refractory lined vessel, a charge of the proper thermit, a pinch of ignition powder, a match, and in half a minute the desired metal is liquid —an attractive proposition. In regard to the uses of titanium as an agent in improving the qualities of cast iron, several metallurgists of note are on record as endorsing its influence. Such writers as Head, Riley, Bauerman and Rossi have investigated the properties of cast iron containing different amounts of titanium. The substance of their work shows a gain in strength and density varying with the content of the element. The indications point to the fact that the mere presence of so much titanium does not mean that it is responsible for the improvement, but rather that the result of its purifying the liquid cast iron during the interval of its being alloyed with it, and that part may have united with certain objectionable bodies present to varying degrees in cast iron, and for which titanium has an affinity, is the main factor in improving cast iron, it being accomplished by making a greater continuity among the molecules of the metal and so increasing the density, or a more intimate connection between the crystals of the iron. The action of titanium is valuable because it is a deoxidizer and also because it has an affinity for nitrogen or nitrides. It is recognized that iron when molten can contain oxygen and nitrogen presumably in their respective combined forms. Therefore, if there is offered a commercial article that will unite with undesirable compounds that usually escape silicon, manganese and carbon as deoxidizers, then a considerable gain has resulted in the achievements of metallurgy. The last named elements are not credited by authorities as possessing attractions for nitrogen. Then titanium can be called a double-acting purifier of cast iron. In order to get a purifying effect in cast iron it is patent it must be brought about after all the harm is done in melting down and before the metal goes into finished product. Therefore, the ladle is the place where the dosing must be done.

It is established that it is practical to judiciously use titanium. Difficulties are offered if it is to be carried in by a ferro-alloy. The metal may be dull, the ferro-alloy may not be small enough or it cannot be pre-heated, hence there will be irregularities of product at the outset. At this juncture the alumino-thermic process fills the gap. By its means it is possible to quickly produce a liquid alloy of iron and titanium at a much higher temperature than the iron to be treated. Thus difficulties of melting and diffusion are removed. The titanium thermit is furnished in cartridges which can be attached to a rod and so plunged into a ladle of molten iron starting a thermit reaction besides agitating the bath of metal. The effect is precisely the same in degree as when using a ferro-alloy. The iron is

cleansed, fluidity is increased, and the grain is closed. Where it is necessary to use much burnt metal in melting stock, the process will wash out the dissolved oxide coming from such stock. It will also promote a complete admixture of the several kinds of metal which may enter into the charge, particularly when steel may have been melted in the cupola or put into the ladle as borings. Another effect is to lessen the tendency of metal to evolve gases, as may be occasionally seen in the form of small brilliant sparks. After a titanium thermit reaction they cease being emitted.

To put before you some evidences of the purifying action of this thermit under consideration, the following tabulations of tests are given which were carried out at the suggestion of your Secretary, Dr. Moldenke, at the plant of the Pennsylvania Malleable Co., McKees Rocks, Pa. It must be remembered that the reason that the gain in transverse strength is not so great, is that the iron treated was of good stock and melted under good practice. Still, it is worthy of notice that it was possible to improve good material. Furthermore, the experiments were conducted on a 5-ton ladle of metal with a can of titanium thermit holding 11 pounds. It can be seen that the influence at the most was limited by the small quantity used:

No. 20886-96

RIEHLE BROS. TESTING MACHINE CO.

Philadelphia, April 17, 1905.

MARKS	Dimensions	Ultimate Strength pounds	Deflection	
1-1 Not treated with titanium thermit	1.000 x .990	4100	1.00	Tests made on one ladle of metal.
1-2 Titanium thermit	.995 x .999	4500	.98	
1-3 Titanium thermit	(Lost in the anneal)			
1-A-4 Treated with titanium thermit	1.011 x 1.010	5920	1.30	
1-A-5 " "	.999 x 1.000	4260	1.27	
1-A-6 " "	.989 x .995	4850	1.55	
2-7 Not treated with titanium thermit	1.060 x .998	4540	1.28	Tests made on one ladle of metal.
2-8 " "	1.012 x 1.006	4610	1.40	
2-9 " "	1.006 x 1.005	4500	1.40	
2-A-10 Treated with titanium thermit	.995 x .996	4620	1.47	
2-A-11 " "	.998 x .996	4410	1.37	
2-A-12 " "	1.011 x 1.00	4810	1.44	

(Signed) E. P. Burton
Eng. of Tests

	Not treated	Treated	Not treated	Treated
SAMPLE NO.	1	1A	2	2A
	per cent.	per cent.	per cent.	per cent.
Manganese,	0.182	0.170	0.167	0.178
Phosphorus,	0.171	0.167	0.166	0.166
Silicon,	0.776	0.776	0.774	0.759
Sulphur,	0.059	0.055	0.061	0.054
Carbon (combined)	2.836	2.91	2.87	2.904
Graphite,	0	0	0	0

(Signed) Edmund H. Miller.

The analyses were made on the gates cut from each set of bars. I have been reliably informed of frequent gains of 20% to 25% in strength where low grade stock was treated by this process. It is well adapted to parts requiring density and smoothness of finish such as calender rolls, locomotive cylinders, motor cylinders, hydraulic fittings, refrigerating machinery, etc.

The next thermit of interest is the one offering a possibility of introducing nickel into molten cast iron. Ordinarily the method is to melt the metal in crucibles. This involves the expense of a separate melting furnace and trouble of melting a highly refractory metal. Nickel has been successfully exploited as a decided adjunct when alloyed with steel, giving improvements in elasticity and ductility, resistance to corrosion and resistance to the influence of heat. It is well known what steel will do when alloyed with cast-iron in definite proportions. Greater advantages are offered with nickel. Cast-iron parts subjected to the influence of chemicals will give a longer life when containing nickel. They will also show a decided improvement in strength, density and fineness of grain. There is also a lessened tendency to rust even from atmospheric conditions. These points are now in demand, but most foundries are not fitted with crucible melting furnaces. I have shown you how it is possible to get a supply of liquid nickel in a few moments by the thermit process and in any desired quantity. This permits great flexibility and adaptability to the needs of the moment, and does not demand an expensive installation and up-keep of melting furnaces.

The thermit process covers considerable ground but it is hoped that the few points touched upon will be instructive to you.

W. M. Carr.

New York, May, 1905.

THE REPAIR OF DRIVING WHEELS BY THERMIT.

BY G. N. PRENTISS, MILWAUKEE.

This article shall be but a brief description of the use of thermit applied to the purpose set forth by the above title.

There are several precautions necessary to be taken in order to make a successful "weld." Of these the most important is to have the molds fit, as the metal produced is very liquid on account of its high temperature, and runs into crevices that metal at the usual temperature would not seek. The molds are made of

a mixture of "bank" and molding sand with enough rye flour to cause the sand to retain its form; where the mold will come into contact with the metal it is faced with silica sand. It is then placed in a core oven and baked, usually over night, in order to drive off all water. Unless this is done the metal will probably be honeycombed. It is also necessary to vent the mold, as sometimes gas will blow the liquid metal away from the place to be welded.

It is best to slot out the fracture so as to present a perfectly clear surface of metal to the liquid thermit steel. It is essential to have everything clean, as a little oil or dirt will surely cause honeycombed metal.

For calculating the quantity of thermit to be used, allow four and a half ounces to the cubic inch of space to be filled, including riser and head; of course, this must be doubled, as the thermit affords only one-half of its weight of metal. Ten per cent. of steel or wrought iron borings or turnings may be mixed with the charge to advantage, for small welds, and may be increased up to twenty per cent. for larger pieces of work.

An additional point to be observed is not to be in too great a hurry in tapping the crucible. Wait until the reaction between the aluminum and iron oxide is complete, and slag separated. This will save much material and regret over a poor job.

The accompanying photographs show a trailer wheel "before and after" two spokes had been repaired.*

Metal from a weld made some time ago gave the following results on being analyzed:

Carbon	.12
Phosphorus	.065
Manganese	.74
Sulphur	.029
Silicon	.86

Tensile strength per square inch, 93,900 lbs.

Summing up, the things to be observed are:

First—Clean surface of parts to be welded.

Second—Molds fitting as perfectly as possible.

Third—Using sufficient thermit.

Fourth—Not hurrying too much.

SHOP ORGANIZATION.

BY WM. H. SICKLES, JERSEY CITY, N. J.

Few men have been placed in charge of a foundry without the question being asked: "Can you handle men to good advantage" or "Can you improve our present methods?" After the agreement is made the foundry superintendent begins to show his ability which, may be very severe, especially if the firm is desirous of putting a quart of fluid in a pint bottle; in other words, expecting a production of ten tons of castings in a five ton shop. When through these efforts, even seven and a half tons have been produced, the question is as to why can't the other two and a half tons be turned out also?

It is well to inspire the men under your charge with confidence in your ability, showing them that you are correct and practical to the minutest details that pertain to the work in hand. Few men have the heart to accept a proposition where there is the slightest appearance of failure, but like brave soldiers, enter joyfully and bravely into battle when the superior officers lead. Treat your men as human beings who have brains and muscle, and they will exert themselves to the utmost because they know a feeling of reciprocity exists, namely, "Live and Let Live."

In the second place: Dispositions vary as much as the separate branches of a tree, and yet all depends upon the fountain head for life. One man would try to impress you with the idea that unless you listen to and abide by his judgment, you would be entirely at sea. That man must be made to respect your opinion, or get him out of your employ. Another who has been with a firm for a life time and who, if he had another one to live, would stay in the same old rut must be lifted out by brighter men, which gives new life to a concern. I do not mean to say that faithful employees should not be rewarded, but they should be encouraged and an effort made to bring them up to a better standard of excellence.

Again: You will find a man who is as earnest and as conscientious in his efforts to succeed as you are to have him to so; you will then bend all your energies to make his efforts successful; you can see by his countenance that he has appreciated your efforts to assist him, and acknowledges his gratitude by special efforts to meet your approbation. That man is a worthy being and a credit to manhood and one with whom you will regret to part.

Now comes the man with good resolutions, as fine a mechanic as ever did a piece of work, but who in an unfortunate moment made the acquaintance with John Barleycorn, and who has not moral courage enough to raise himself beyond its influence. Pity such a man; he is still human and in other days has done

*See page 118 for illustration.

better. Sometimes you must have just such men in your employ, mechanics being scarce, and they are better than none. Then exercise good judgment and you will make that man a most valuable ally in your efforts to increase your production.

And still another problem arises, which robs the superintendent of his best results, unless he is master of the situation. I refer to that class of mechanics who depend upon the influences in the office of the firm or on some influential friend; and who when they get a position think they cannot be removed. Such men are invariably enemies of good discipline, and will do more injury in a week than can be repaired in a month.

Another stepping-stone to successful management is the creation of friendly rivalry among the men, encouraging those who are doing well and inspiring those less fortunate with a desire to excel, thereby raising the efficiency of all the men in your employ. I have been where it was decidedly difficult to obtain men and had to resort to boys to succeed in getting out the production. I had some boys who by constant application succeeded so well in the course of a year and a half that they could compete with and were decidedly better than some journeymen. I have also been in charge under managers who knew comparatively nothing about the business, except as acquired by their interviews with the men, and who imposed upon the owners by bluff, frequently changed the heads of departments to the detriment of the firm and to their own downfall, and ignoring all the advice that was given in a friendly way.

In recapitulation, I would say, first: A foundry superintendent should become acquainted with the present methods of the shop and the work, and then improve it if he can. Second: Become acquainted with the dispositions of the men, and to those who are conscientious and honest, give encouragement; to those who are lazy and slothful, give them your most severe treatment. Third: Encourage the boys, so that they will become practical and most useful men in the end. Fourth: Avoid the man of bluff, because he is like a fungus growth, simply clinging while life exists in something else, and even sapping that life away when he gets the opportunity. When that life is exhausted, he sinks to the earth, despised and ignored, and is soon forgotten except for the ruin that he has wrought.

Let us then learn the great lesson of handling men. Use patience, constant application, untiring energy, and reward will be ours.

VARIATIONS IN THE PROPERTIES OF ALLOYS.*

BY PERCY LONGMUIR, SHEFFIELD, ENGLAND.

The brass founder oftentimes runs across such erratic behavior on the part of his castings that ordinary practice will not explain it, the general run of the castings having been made under supposedly identical conditions.

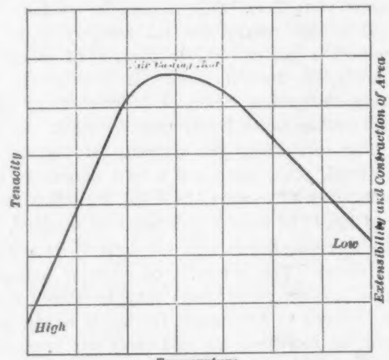


Fig. 1

In order to determine the cause of these difficulties, a series of thirty separate melts from one alloy was made, the composition of the alloy being the same, and several test bars from each melt being machined and tested. The bars were all sound, machined up true, and presented the same color and appearance. When tested these bars showed up astonishing

FIG. 2. METHOD OF MEASURING CASTING TEMPERATURES.

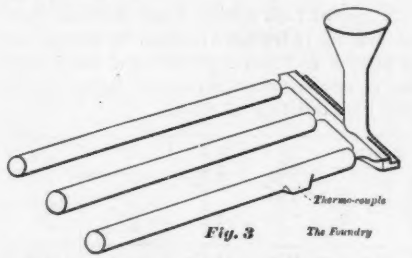
variations. The strongest series of bars had an average tensile strength of 26 tons per square inch, with 51 percent elongation, while the weakest average was 12 tons per square

*Abstract of paper read before the American Foundrymen's Association, June 7, 1905, by Dr. Scholl, editor of *The Metal Industry*.

(To be Continued.)

inch, with only 5 percent elongation. Comparisons with test bars cut from bronze castings, which were afterwards remelted and then tested again, showed that the clue to the great variation lay in the pouring temperature of the metal.

While extremely low pouring temperatures are known to give poor results, yet within the range of what might be termed proper temperatures for pouring castings there are intervals of time which have appreciable influence on the result.



Making a series of castings from a melt at one-half minute intervals, and testing for tensile strength, we get a curve showing in its highest point the best casting temperature. Naturally the shape of the curve (Fig. 1) will depend upon the amount of metal handled, a small crucible full of metal cooling quickly and making a very sharp curve; while a large body of metal cooling slowly, the "fair casting" heat has a wider range.

No experiment represents a less weight than

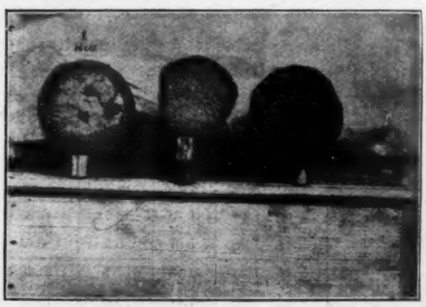


FIG 4. GUN METAL RUNNER HEADS IN ORDER OF CASTING.

50 lbs.; each test reported represents the mean of two concordant determinations, and the analyses represent not the composition charged, but the actual analysis of the resulting castings. The method of measuring the temperature is shown in Fig. 2, which reproduces three

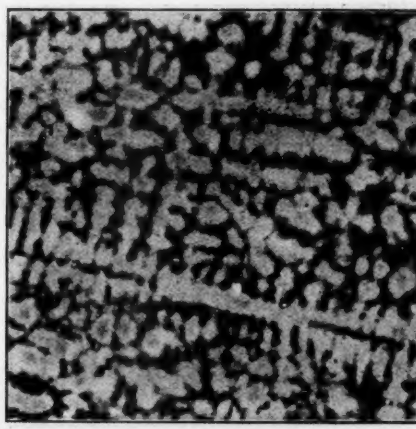


FIG. 5. STRUCTURE OF GUN METAL POURED AT THE "HIGH" TEMPERATURE. MAGNIFIED 58 DIAS.

boxes ready for casting. One set of castings is shown in Fig. 3, the position where the thermo couple entered being marked. Three thermo junctions, one to each box, were employed, and by means of the switch shown in Fig. 2 any one could be readily connected with the galvanometer leads. The actual temperatures were obtained from the deflection of the galvanometer. In casting, three distinct temperatures of "high," "fair" and "low" were obtained from each alloy. Thus each alloy was raised to the highest safe temperature, the crucible drawn, its contents stirred and one set of bars cast. The crucible then stood until

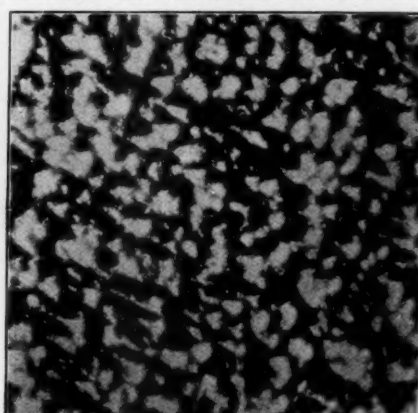


FIG. 6. STRUCTURE OF GUN METAL POURED AT THE "FAIR" TEMPERATURE. MAGNIFIED 58 DIAS.

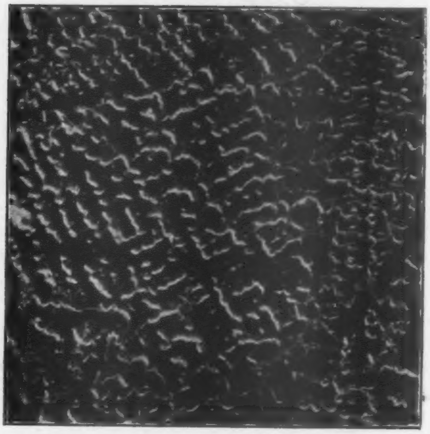


FIG. 7. STRUCTURE OF GUN METAL POURED AT THE "LOW" TEMPERATURE. MAGNIFIED 58 DIAS.

the temperature had fallen to a fair casting heat and, after stirring, the second set of bars was poured. The third set represents the lowest safe temperature consistent with fluidity. Each representative temperature was measured as shown, and the reason for stirring before each cast is obvious.

A crucible of molten brass whilst standing emits fumes of zinc oxide and it would appear that the castings representing different temperatures would differ chemically. Such, however, is not the case, and careful analytical examination has proved that the composition does not vary, the three sets of castings always being precisely the same chemically. This is interesting in that it points to the loss of—zinc, for instance—being determined by the highest temperature reached, and from which down to solidification no further loss occurs. Therefore, zinc fumes given off during cooling represent oxide formed on heating. Every condition except one being identical and there being no chemical difference, it follows that any variations found in properties are due entirely to difference in casting temperature.

FIG. 8. MUNTZ METAL POURED AT THE "HIGH" TEMPERATURE. MAGNIFIED 260 DIAS.

A type of high quality steam metal in British practice is formed of copper 88 percent, tin 10 percent and zinc 2 percent, and the following results are characteristic of many experiments on this type of alloy.

Analysis			Casting Temperature °C	Max. Stress Tons per sq. in.	Elongation % on 2"	Reduction of Area %
Copper %	Tin %	Zinc %				
87.5	10.2	1.8	1173°	8.37	5.5	4.23
			1069°	14.83	14.5	16.71
			965°	11.01	5.0	6.36

A usual specification for castings of the foregoing alloy is a tensile strength of 14 tons per square inch, an elongation of not less than 7½ percent on 2 in., whilst steam fittings must pass a water test of 1,700 lbs. Evidently the first and third castings would hopelessly fail to meet such a specification; yet the three were poured from one 60-lb. crucible, and the middle one is separated from the first and third by the narrow time margin of only two minutes on either side.

The following table embodies results obtained from copper-zinc alloys:

Alloy	Analysis		Casting Temperature °C.	Max Stress Tons per sq. in.	Elongation % on 2"	Reduction of Area %
	Copper	Zinc				
Red Brass	89.6	10.2	1308	6.85	13.2	12.65
			1073	12.64	26.0	30.28
			1058	5.67	5.5	6.64
Yellow Brass	73.0	26.0	1182	11.48	37.7	31.40
			1020	12.71	43.0	35.66
			850	7.44	15.0	15.25
Muntz Metal	58.6	40.5	1038	12.45	6.0	10.60
			973	18.88	15.0	16.10
			943	16.28	9.5	14.81

The results obtained from the red brass alloy which is largely used as a brazing metal are of special moment, and it will be noted that a fall of 235 percent C. in casting temperature doubles the mechanical properties; whilst a comparatively slight further fall re-

sults in a very considerable lowering of these properties. The yellow brass results follow the same order, but here the fair casting heat appears to extend over a wider range, for the two first results are not greatly different. The third one, however, speaks very powerfully as to the influence of a low casting temperature. The susceptibility of a high zinc alloy to variations in casting temperature is well shown in the Muntz metal results. Each of the foregoing alloys being constant in composition and every condition save that of casting temperature being identical, it necessarily follows that variations in mechanical properties are determined solely by variations of initial temperature.

Taking another feature, that of specific gravity, values obtained from the foregoing alloys will be found in the following table:

Alloy.	Casting Temperature °C.	Specific Gravity
Gun Metal	1173	7.2563
	1069	8.2583
	965	8.5104
Red Brass	13·8	8.2768
	1073	8.5565
	1058	8.5372
Yellow Brass	1182	8.0533
	1020	8.1089
	850	8.1418
Muntz Metal	1038	7.7844
	973	8.0313
	943	8.3503

It will be noted that generally the densities of each alloy increase with a falling casting temperature. Another aspect of this is shown in Fig. 4, which reproduces the runner heads of the gun metal castings. The high temperature head not only shows no "feed," but actually presents an expansion or "swelling," as shown by the ring of metal running two-thirds of the circumference of the head. The fair heat shows uniform feeding in all directions, the head being originally the same diameter as the first one, but during the process of uniform feeding it has lessened by settling down the funnel-shaped head mould. The third head shows that feeding tends to take the form of a central pipe. The practical value of these features is easily recognized, for castings attached to such a head as No. 1 will, when tested under water pressure, yield results decidedly inferior to similar castings from heads such as No. 2. The feeding of No. 3 tending to take the form of a central pipe will give rise to local defects in the heavier parts of the casting familiarly shown in the form of "draw holes."

In studying the reasons for the peculiar behavior of the alloys so far shown as affected by their casting temperature, one has to look for the force that binds the crystals together. The microscope gives good information on this point. Thus, Figs. 5, 6 and 7 show the structure of three gun metal castings poured from one crucible at suitable intervals all within the range of fluidity.

They are, like the mechanical properties, essentially distinct from one another, although all precisely the same chemically. Long-continued observation has led to the following conclusions in which for convenience three typical casting temperatures, "high," "fair" and "low," are taken. "High" casting temperatures, Fig. 5, favor a large, ill-developed type of crystallization, giving a characteristically "loose" type of structure. Fair casting heats,

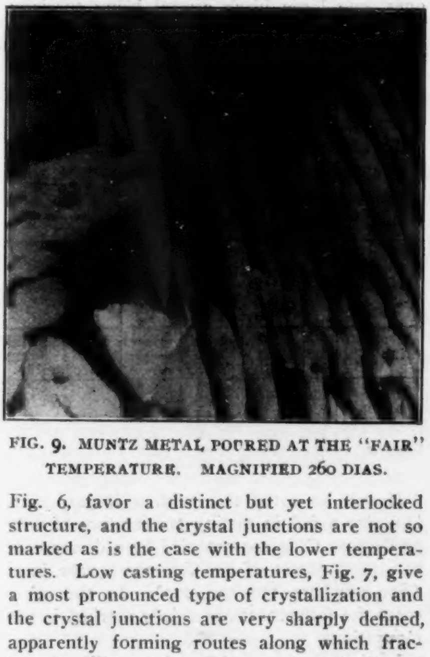


FIG. 9. MUNTZ METAL POURED AT THE "FAIR" TEMPERATURE. MAGNIFIED 260 DIAS.

Fig. 6, favor a distinct but yet interlocked structure, and the crystal junctions are not so marked as is the case with the lower temperatures. Low casting temperatures, Fig. 7, give a most pronounced type of crystallization and the crystal junctions are very sharply defined, apparently forming routes along which fracture readily travels. Summarizing these conclusions, it will be seen that

"High" casting temperatures give a loose structure.

"Fair" casting temperatures give an interlocked structure.

"Low" casting temperatures give a sharp structure.

The behavior of castings possessing these types of structure under steam or water test is as follows: Loose structures allow steam or water under pressure to ooze through the minute interstices of adjacent crystals. Interlocked structure effectually prevents any per-

colation of this kind, and the castings are therefore tight within all pressures up to their limit of deformation. Sharp structures familiar to castings poured at a low heat will, if the crystal junctions favor, and they generally do, offer microscopical routes of penetration similar to those of high temperature castings.

Turning to a copper zinc alloy, three typical structures of Muntz metal are reproduced in Figs. 8, 9 and 10. In these photographs the black crystals represent a high zinc compound Zn_2 Cu (2 zinc, 1 copper), whilst the white ones represent a compound Cu_2 Zn (2 copper, 1 zinc). The crystallization of Fig. 8 is relatively larger than that of the two following ones, one large black crystal being specially noteworthy. The "interlocked" structure of Fig. 9 is shown in the difference of direction taken by the long white crystals. The sharp structure of the low casting heat is well shown in its pronounced crystallization.

To see whether the above reasoning would hold good for commercially pure metals, zinc, aluminum, lead and copper were selected. The results were as follows:

Metal	No.	Casting Temperature °C	Max. Stress Tons per sq. in.	Elongation per cent on 2"	Remarks
Zinc	118	580	1.30	——	Poured at intervals from one crucible.
	119	528	1.81	——	
	120	491	1.37	——	
Aluminium.	121	725	4.48	2.5	do
	122	691	5.62	8.5	
	123	662	5.12	5.0	
Copper	124	1500	7.60	8.5	do
	125	1446	7.80	11.5	
	126	1141	8.80	8.0	

It will be noted that with a fragile metal like zinc a fall in casting temperature of only 37 degrees C. is accompanied by a decrease in maximum stress of 986 lbs. per square inch. (See numbers 119 and 120). In the other cases the differences are chiefly marked in the elongations.

Lead is characteristic in that, unlike zinc, it can be highly superheated. A crucible so heated and bars cast representing a very high casting temperature, when tested in the tensile testing machine, yielded an elongation of 8½ percent on 2 in. Bars poured from the same crucibles after standing four minutes gave elongation of 35%. With lead the fair casting heat appears to be near the solidification point, and it is extremely difficult to obtain perfect castings typical of a low temperature, a feature explained by the absence of fluidity near the freezing point. The following results represent normal temperature variations and not exceptional ones, like the one just quoted, for commercial lead, each three results representing three temperatures from one crucible:

No.	Casting Temperature °C	Max. Stress Tons per sq. in.	Elongation per cent on 2"	Remarks
127	566	1.70	40.0	Tested some time after casting.
128	426	1.71	40.0	
129	356	1.64	35.0	
130	580	1.13	18.0	Tested the day following casting.
131	430	1.43	35.0	
132	360	1.30	42.0	
133	580	1.44	30.0	Companion Bars of 130, 131 and 132 tested 3 months after casting.
134	430	1.46	37.5	
135	360	1.46	46.5	
136	575	1.41	20.0	Tested six days after casting.
137	450	1.47	35.0	
138	370	1.51	50.0	

The first set of bars are, in spite of differences in casting temperature, practically equal in mechanical properties. These particular bars were poured some considerable time before testing, and in the interval were stored in a room at an unknown temperature but one

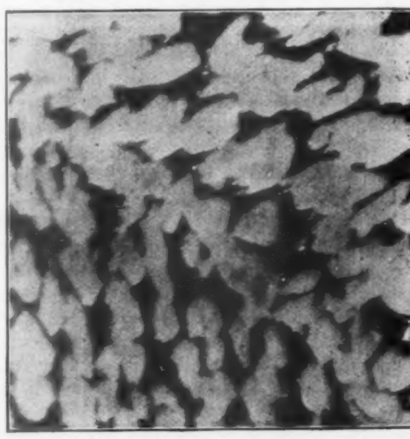


FIG. 10. MUNTZ METAL POURED AT THE "LOW" TEMPERATURE. MAGNIFIED 360 DIAS.

above atmospheric. These results, therefore, point to a recrystallization taking place at comparatively low temperatures, which is such as to entirely eliminate the influence of varying casting temperature. Nos. 133, 134 and 135, which are respectively companion bars of 130, 131 and 132, illustrate this feature, but here the interval of three months has not been sufficient to entirely eliminate the variations due to the varying casting temperature.

Special attention is called to this feature because it is the only case in which a neutraliza-

tion of the influence of varying casting temperatures was obtained.

Various forms of after treatment applied to practically every commercial alloy and metal have not, except in the one case of lead, brought the properties to one level. With this exception, companion bars poured from one crucible at different heats, no matter how they are improved by the "treatment," always remain a relative distance apart. Taking the copper, the results of which in the cast condition have already been given, the following two forms of after treatment show the survival of the variations due to casting temperature.

No.	Casting Temperature °C.	Max. Stress Tons per sq. in.	Elongation per cent on 2"	Remarks
124A	1500	4.52	8.0	Nos. 124, 125 and 126 heated to 646 °C and cooled in air.
125A	1446	6 86	10.0	
126A	1141	8.51	8.0	
124Q	1500	5.80	9.0	Nos. 124, 125, and 126 quenched in water from temperature of 543 °C.
125Q	1446	8 36	15.5	
126Q	1141	9.04	10 0	

A SOUTH GERMAN LABORATORY.

BY C. C. MACPHERRAN, MILWAUKEE, WIS.

Much of late has been said in comparison between the American and European methods in foundry laboratories and foundry practice, and yet when all the conditions are known I think there is as much difference in the practice in different parts of America as in the practice of America and Europe. It is in all cases an adaptation to the existing conditions.

The time allowed has more to do with the difference in chemical methods than has any other condition; even as the price of labor has much to do with the practice in the foundry. We say that the German chemists are very accurate but slow, and there is much truth in that. The American would like to be as accurate, but is seldom allowed sufficient time to be absolutely sure. He must combine speed with what may be termed "practical accuracy." I will give here a brief description of a laboratory in South Germany, of which, for a time, I had charge.

The laboratory was one step up from the street, with cement floors throughout, each room draining of to a sewer connection in one corner for convenience in washing out. Next to the laboratory proper was the office and scale room, and beyond the testing and preparation room. This proved to be a very convenient arrangement.

The samples were brought in by the laboratory sampler, worked up, placed in envelopes, labeled and handed to the chief. In iron, the laboratory usually determined the SiP, Mn and S and rarely the C. C. and Graph. C. The Si and P were worked together. The sample taken up in HCl, HNO_3 run slowly to dryness, taken up again in HNO_3, diluted, filtered and washed. The residue on the paper reserved for Si and the filtrate used for P. Sometimes by Emmerton and sometimes gravimetrically for a check.

The Mn is usually done by Volhardt's method.

The C by the chromic acid method.

The S by Ledebur's method, which is the evolution of the H_2S by HCl in a flask having a condenser in the neck, so that the contents may be boiled without danger of the HCl coming over. A stream of CO_2 is run through to insure the passage of all of the H_2S and to prevent oxidation. The S is caught in a solution of cadmium acetate. The Cd replaced by Cu on addition of $CuSO_4$ solution. The CuS is filtered out, washed clean, the paper burned off at a low heat and the residue weighed as CuO, the S to be calculated from the CuO. The coke is worked for ash and sulphur. The S by Eachkas' method.

German cokes as a usual thing are not so good as our Connellsville. The by-product coke is much the same, but the natural coke runs much higher in S and ash (S .90 to 1.25 and ash 13. to 15.), and is a dirtier, smaller coke than our better grades.

The cupolas in South Germany are of so many kinds and shapes that I will describe only one type which we used to good advantage, and which was in pretty general use in the country round. This cupola lined to 40-in. diameter straight down to 25 in. above the main tuyere where the bosh wall began, running in to 32 in diameter at 2 in above the tuyere and thence straight down to the bottom. The upper tuyeres were eight round pipes 1¼ in. diameter run through at the top of the bosh wall, pointing downward at an angle of 30 degrees.

The main tuyere was an opening 2¼ in. high, running all the way around the cupola and was about 16 in. above the bottom. This was an average size for that section, the tendency being rather toward small cupolas and several of them, in place of one cupola of very large size. This may not seem economical, but they find it very satisfactory.

This cupola (1 of 7 in our foundries), melted iron for the year I was there at a rate of between 4 and 5 tons per hour, furnishing very

hot iron at a fuel ratio of 1 to 9.75. This was done with coke inferior to our best Connellsville and the writer is not much of a believer in big fuel ratios either.

The irons used in the foundries were principally three brands:

Lilleshall Lodge	Si. 2.00 to 3.00 P. 1.25 to 1.75	S. .050 to .130 Mn. .60 to 1.00
Luxemburg	Si. 1.50 to 2.50 P. 1.25 to 2.00	S. .050 to 1 50 Mn. 1.00 to 1.50
Krupp (Bessemer)	Si. 1.50 to 3.00 P. .10—	S. .020 to .035 Mn. .75 to 1.25

The mixtures were figured down to three standard irons, with some specials which were only cast occasionally, such as chill irons, etc.

The three standard mixtures used were as follows:

Analyses of Castings.

Cylinder Iron	Si. 1.50 to 1.60 P. .60 to .70	S. .100 to .140 Mn. .70 to 1.00
Fly Wheel Iron	Si. 1.90 to 2.00 P. .90 to 1.10	S. .115 to .150 Mn. .60 to .80
Common Iron	Si. 2.25 to 2.40 P. 1.00 to 1.30	S. .100 to .130 Mn. .60 to .80

The strength of bars cast from these irons, reduced to our standard (1 in. x 1 in. x 12 in.), were as follows:

Cylinder Iron	2800 to 3000
Fly Wheel Iron	2500 to 2800
Common Iron	2000 to 2300

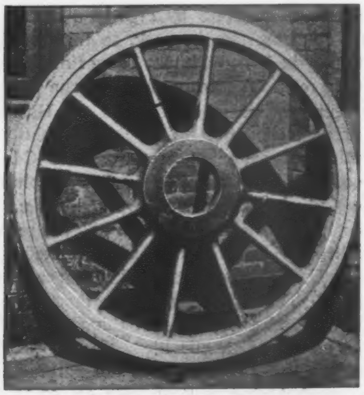
The quality of the iron was good, machined easily, finished clean, and held steam well. This would rather indicate that we Americans have been somewhat over careful of our S. The riser heads on finished work are higher and heavier than ours; the molds are more freely vented and the gates and runners larger.

Nearly all work of special type, all of it over two to three hundred pounds, is made in dry sand and the larger pieces in the floor; except the cylinders. Very heavy pieces are made in loam as here. None of the big work is anchored or clamped. All of it is weighted.

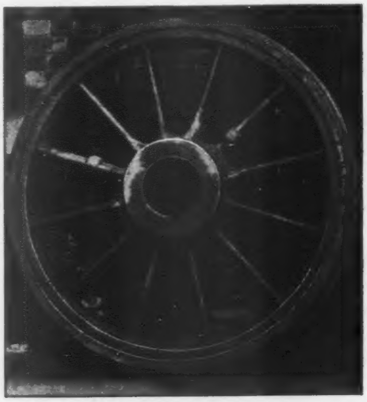
The sand is a mixture made at the plant. A rather coarse sand, which has considerable iron and almost no clay, is the base; to this are added fine sand from another bank and clay, in proportions fitting it for the different grades of work in which it is to be used.

Piece work is almost as well paid there as here, but the men there seem satisfied with a little more than half what would satisfy an American molder.

Machine molding, when I went there, was not directly in favor, but with the introduction of the convenient, light, handy American machines, came a change of opinion and when I left we had quite a battery at work on stock pieces for their farm implements and smaller engine pieces.



WHEEL BEFORE WELDING



WHEEL AFTER WELDING

THE REPAIR OF DRIVING WHEELS WITH THERMIT. SEE PAGE 110

TENDENCIES IN THE FOUNDRY INDUSTRY.

BY DR. R. MOLDENKE, WATCHUNG, N. J.

To one who is constantly brought into touch with the demands of the discriminating consumer of the foundry product on the one hand, and who also knows the limitations the foundryman is working under in producing these castings, on the other, there become manifest certain tendencies that it

will be well to recognize in order to be prepared for the inevitable when it finally arrives. Apart from the revolution in the foundry from old time customs, there is manifest to-day a tendency toward refinement in method little dreamed of by the most ardent iconoclasts of a decade ago.

Perhaps our peculiar situation in this country, where the foundry is engaged in pushing specialties to the limit, has enabled us to take the lead in many directions. On the other hand we must deplore the lack of interest in, or shall we say lack of time for, many things, which if properly followed up, would remedy many a difficulty with our cost accounts. For instance, the adapting of the molding machine for production in quantity. This is sometimes truly marvelous, yet how little is known of it outside of the shops where this development has taken place. Again, how little is done by the producers of coke and pig iron to bring the ordinary classes of these materials up to the standard of what we now term "fancy" articles.

The importance of a thorough knowledge of the materials entering the foundry is becoming more manifest daily, and I remember distinctly the adverse criticism a book on cast iron came in for at the time of its publication because it went into the production of coke and pig iron too extensively. Today we see that it is good to know how these processes are carried out, as we can more easily trace the causes of loss and difficulty in the foundry; conditions not realized by the makers of these materials, as they are not using them daily in the difficult art of making castings of the highest quality for the lowest price. I might go further and say that the founder who is also thoroughly versed in the art of casting brass and bronze, is more apt to be particular with the iron end of his concern, and can overcome occasional metallurgical puzzles more easily.

Perhaps the very first thing which strikes the European foundryman who is visiting our plants, is the great stress laid upon system and organization in our strictly modern establishments. Where the European founder, with his more varied work of smaller aggregate tonnage, casts his pieces one by one, and finishes each with the assembling following directly, we, with an eye to the finer economies, prefer to put through an order of anywhere from a dozen to thousands of pieces of a kind, finishing them up for stock, and stealing the parts required for the sales and promises. As the stock in warehouse gets below a certain minimum, another shop order goes in to fill up the gap. As a consequence the work is always produced at the cheapest rates possible.

Here we strike the first tendency in the foundry industry. The specialization of our shops. It goes without saying that our European friends—and be it remarked that for over 20 years a steady stream of the most intelligent, observing, and highly trained men have been visiting our plants with the avowed purpose of learning how we do things—quickly note the advantages we derive from our remarkably efficient systems of shop and office organization, and are introducing this American tendency into their respective countries as fast as they can be absorbed there. The result is a world-wide tendency in the foundry industry, which will have to be reckoned with some day from a competitive standpoint.

From this general point of interest, we can now get down more to particulars. Let us examine the noticeable tendencies in the foundry on the molding floor, the melting department, the laboratory, and the management, with the many problems this has to solve. Then the industries which supply materials for our work, and lastly the tendencies of the foundry industry as a whole.

If we take into consideration that specialty work means the production of the same casting in very large quantities, we can see why machine molding in its various phases is beginning to play such an important role. I have personally known single orders of 100,000 castings of some 30 lbs. each given with simply a blue print of the casting attached to the document. Many times the quantity has been 30,000 to 60,000, which meant that economical work could be done here if anywhere. Actually the figures at which these castings were carried out would be astonishing.

Apart from the use of molding machines to turn out these classes of castings cheaply, there is a noticeable tendency to economize shop room, and hence molds are piled as high as they can be conveniently poured, it may be objected that this method oftentimes produces more sprues per pound of casting

than the old way, and that if trouble comes, a stack of molds will be ruined instead of only a single one. Yet this system has been found to pay wherever tried, and the getting of more tonnage for a given floor space is bound to spread. The idea, however, should be followed out to its logical end wherever work is made in sufficient quantity. This would seem to be the stacking up of the molds in fairly deep foundry pits, the iron being brought in large ladles by traveling crane, and poured from the bottom of the ladle. Suitable variations in the method can naturally be devised for given cases but the idea remains the same; to get the greatest tonnage for a given floor space, in order to save investment and cost of output.

Greater attention will ultimately be given the preparation of the molding sand. Our European brethen are far ahead of us in this respect, every foundry of importance grinding its sand to a given standard, then passing through mixers which incidentally fill the perfectly uniform material with maximum of air, thus cushioning the sand and keeping it as open as it may be. When a highly refractory, molding sand is used, this treatment assists in turning out the smoothest kind of work. As our consumers are constantly harping on better looking work, this point might be considered more carefully by American foundrymen. Many sands are exceedingly uniform in their natural state, as for instance the well-known "Albany," the result being highly finished castings, where the best molding methods are employed. On the other hand, who does not recognize a "Pittsburg" casting, that is one made in the sand dug in the environments of the smoky city. Judicious sand treatment would go a great ways to remedy the difficulty even there, did the good people make the class of work current in the eastern states. What great differences may exist in molding sand in the same heap may be seen in an exagerated way where sand conveyors are in use. Here, unless special precautions are taken, the loamy particles in the sand may get together, leaving the silicious portions without a binder. The result is that copes drop out, scabs are formed, etc. No wonder that in the ordinary tempering of sand an art is involved which must be acquired before a man can rate himself proficient in this branch of the work. Hence the tendency to get away from imperfections in the make-up of the molding sand heaps, by mechanical grinding and mixing. This tendency has not struck our country very hard yet.

Attention may be called here to the fact that a very noticeable tendency is being manifested by the manufacturers of foundry facings and other supplies of a like order, to learn more of their own art. The foundry industry as a whole is bound to benefit by this, and we wish our facing brethen all imaginable success.

Before leaving this branch of our subject, we must not forget to mention the growing tendency to perform as many operations about the foundry as possible by mechanical means. We have now some excellent examples of what may be done in this way in our advanced foundries. Whether it be the mechanical charging of the cupola, the mold and sand conveyors, metal distribution, compressed-air attachments, yard cranes, and the like, the tendency is to be encouraged as much as possible, as wherever the manual labor of several men can be replaced by the brains of only one, conditions of management are much easier to meet. The investment may become higher, but competition can be better met, and as a general proposition the resources of the nation are employed to its greatest advantage.

Perhaps this is as good a place as any to mention the growing demand for foundry standards. Thus flasks, pattern work, and the molding methods depending upon the close co-operation of the pattern shop with the molding floor, are coming in for considerable attention. The makers of molding machines will be greatly benefited by this desired standardization of flasks, for the time has now gone by when a manufacturer would go out of his way to get the most impossible screw thread, in order that the repairs subsequently necessary would have to come to him. We shall undoubtedly see the day when all the designs of the drafting office of an industrial establishment will go for revision to its foundry superintendent, in order to standardize the non-essential elements therein and create less labor in producing the castings.

In going through many a foundry where very large loam molds are made for stock work, one cannot help regretting the tearing down of much of the mold which might

be left standing if the subject of "permanent molds" had been studied more carefully by the foundry foreman. The tendency today is to economize in every way possible, and very often here is a chance to begin.

We owe much to our high class custom pattern shops for the progress they have forced upon the pattern end of our industry. It is not so long ago that metal patterns were unheard of in many foundries. It seemed like a waste of good money to put more time and effort on a pattern than was required by the ordinary article we all have piled on our pattern shelves. However, this tendency is growing steadily, and many a shop today can boast of a set of metal cutting machines which remind one of a first class toolroom. This tendency is, however, closely interwoven with the specialization of the foundry, and where a first class man is in charge, the pattern storage soon becomes less of a grave yard for obsolete material.

Perhaps we can also note a marked tendency toward more substantial buildings. Wood is becoming dearer. Fires are more disastrous to the business than to the shop itself. Hence greater precautions to prevent shutting down when least able to stand it. Whether foundrymen are becoming richer, or are more progressive is hard to say, but the number of new buildings going up to replace worn out and tumble down shacks is very gratifying.

Turning now to the melting and the closely allied laboratory, we see that the strongest marked tendency of the day in the industry is the production of higher grade castings by the addition of steel scrap, or in other words the reduction of the total carbon in cast iron, making the crystalline structure more closely adherent, and hence the whole casting stronger. Here the skill of the melter is joined with that of the chemist, so that value is received from the higher priced stock charged into the cupola. The cupola process is being studied more carefully and experts in that line can produce results close to those of the air furnace, or open hearth. Considering that this is accomplished with fuel and metal in contact, and by a notoriously unsatisfactory melting method, which the cupola process undoubtedly is from the standpoint of the treatment the metal gets in it, the foundry industry is to be congratulated upon its ability to retain a strong hold on the making of castings, in the face of the hard knocks it is getting from the steel casting establishments.

This tendency toward better grades of metal is but in its infancy. The cupola, which is a cheap melter, will undoubtedly be improved with the view of getting better results from the steel scrap additions. The metal will be safe-guarded more from burning, and the additions of the scrap will be systematized more, so that a given quantity will produce given results more regularly than is now the case.

The tendency above mentioned has somewhat retarded the introduction of air furnaces in general foundry practice. However, taking into consideration the demand for better irons, better coke, better melting methods, the specialist founder will soon tire of buying high class material, and spoiling it, or taking big chances in that direction. He will naturaly revert to the air furnace as better able to give high class results from high class material, and the consumer will be glad to pay the difference.

Those who have taken the trouble to follow the silver and copper market will have noted that the high levels reached are not due to spasmodic fluctuation made by financial manipulation, but are the result of a real ability on the part of the civilized world to absorb these metals. We have the same thing in the iron market. The swing of the pendulum from the 21,000,000 mark will soon carry the consumption of the metal far into the thirty or forty millions and unless the country can produce this quantity steadily, the price is bound to rise sharply. Now, today we find few men in our line of work who are out for abnormally high prices for their product. We all wish for nothing better than a fair profit on base purchase prices which are fair to the furnace and coke dealers as well as to us. Hence the output of our establishments will be kept as much as possible within conservative price limits, and the quantity will be made to increase gradually. It may, however, be said that the resources of the country will not be able to respond quite as fast as the demands that the rapidly increasing population is making upon them, and hence we will never see the days of 1894 prices again. For which let us be thankful. All this means that with better

prices even if pig iron and coke hold well up, a more liberal tendency in the way of investment is bound to manifest itself, and everybody will be the gainer.

Whereas once the melting point of the various cast irons formed the one absorbing topic for articles and discussion, at present it is the elimination of sulphur in the cupola. This is a good sign, and even if one man finds that he cannot get the results of the other, and therefore we are at present quite at sea regarding a desirable method, yet it shows a tendency, and a good one.

With more light on this question, it is but a step to work on others and finally we may get down to a closer study of the burning effects manifested in cupola and air furnace practice, which I hold, are the most important by far of all the phenomena of the foundry melting processes, granted that the chemical composition is otherwise correct.

This leads us to the use of the ferro-alloys in the foundry to correct the evils we know, and others we have a vague apprehension of. Today the use of ferro-manganese and of aluminum is quite extended, and is really a help in many instances. With the poor pig iron and especially the very poor coke the smaller founder is forced to put up with, the use of either of the above mentioned correctives is to be recommended. Unfortunately ferro-manganese is hardly powerful enough to do much good in the foundry, unless the mixture has a goodly proportion of steel in it. When this is the case it means a higher melting point, and with higher temperatures than ordinary cast iron is apt to be poured at, much of the oxidation is removed, and we avoid the pin holes, other weakening and unsightly effects which seem to be somewhat the rule at the present day. The real foundry alloy, however, is still to be discovered and made commercially, and the day cannot come too soon for this desideratum to be realized.

I look porward to great improvements in the making of producer gas. We hear of mysterious developments across the water, by which a more powerful heating agent is secured. How true the reports are we cannot say, but that work is being done in that direction is certain. It may mean a cheaper and more powerful fuel gas, and if so, it has a good place in the modern foundry, for whoever has worked with gas instead of coal, will stick to the former until the price soars out of sight. Just how this tendency will work itself out in the foundry is hard to say. Whether it means the use of the open-hearth furnace in the big foundries, or the making of electricity with the gas engine in the smaller foundries for use in melting, time will determine, but it is well to keep this development before us, and to profit thereby.

This brings us to the consideration of another matter. The Canadian government is doing much to foster the development of electric smelting. The makers of the latest types of electric furnaces are constantly getting better efficiences. Now with a cheap gas, in a gas engine, and for the making of very small castings in small quantity, there is no reason why the small steel, malleable, and even gray casting industry, not to speak of the brass and bronze contingent, should not melt their stock in the electric furnace. The higher price of the work sold will probably stand this. This tendency will bear watching. I have recently noticed a neat suggestion by Dr. Waldo along this line, where he proposes to make Bessemer steel rings or suitably shaped small ingots, these to be of the composition of the steel casting. Now by charging these small ingots into the electric furnace, one obtains a fluid steel of the proper composition to cast. I would suggest as an improvement that the ingots be pre-heated up to the highest point possible without injury to the metal; say just as the ingots for rails or structural steel are treated. This would leave for the more expensive electric current only the finishing heat necessary to melt and superheat to the point right for pouring.

The few remarks above will show our foundrymen that we are by no means through with the improvement of our processes, and were it possible to enlist an active encouragement on the part of the industry, many of these very direct problems could be attacked, and possibly solved.

Finally we come to the general problems of the foundry, in which there are also marked tendencies for a change. This will probably affect only the very large industries for the present and next generation, but what may come after is hard to say. Fore-

most stands the rapidly increasing use of direct metal. This is more marked across the water, but is bound to come here also. The big segments for the tunnel shields and linings should never have been made of remelted metal. However, this does not mean that it was advisable from the first to jump into a new method for such vast contracts. Here again we strike the importance of the use of steel scrap in gray iron castings, in order to reduce the total carbon. I would not advocate the use of direct metal just as it is, but to have the stream of metal from the blast furnace go into large heated mixers, which means greater, in fact more easily attained uniformity than is ever possible with the cupola. Now into this mixer there should be charged successively quantities of steel scrap which has been heated up to almost melting. This accomplishes a two-fold purpose. First it gives a reduction of total carbon without lowering the temperature of the metal in the mixer too seriously not to be corrected at once by the heating method used as well as the comparatively large quantity of metal that should be in the mixer all the time. Now the first result is the making of a high grade cast iron. This iron should be good enough for all the purposes the process could be used for, such as the making of pipe, tunnel segments, ingot molds, etc.

The second effect of the addition of the preheated steel scrap is that the problem of "kish" is done away with. This is the bugbear of the direct metal foundry, and in fact has retarded the introduction of direct metal for important work so much that at one time it was thought out of question to think of ever going back to this centuries old way of making castings.

What then will be the result of this tendency? It means that blast furnaces will be located wherever the raw materials not only are favorable, but where there is a good shipping point for pipe, possible car wheels, and not impossible, malleable castings for car work. The furnace proposition will then become one of allied industries to give an outlet for the pig iron made which will fit these uses, and all the pig iron not of composition to go into the various mixers will be put upon the market.

While this seems visionary, it is nevertheless a fact that one very large combination is about to break ground for just such an establishment, and we may hear from direct metal pipe very soon. With our American enterprise, one hesitates to say just where those changes in method of production as well as administration will end, and it is even within the range of possibilities to find stoves made at a blast furnace, once the molding machine has conquered the field that is before it in that line.

Being in fairly close touch with the scientific and administrative end of the foundry industry, I can say that most of these tendencies have been put up right against me in one way or another during the last few years, and I can safely say that with the need of betterments at hand, and this need no longer capable of being attended to by the old fashioned yet highly respected men on the foundry floor; it remains for the men at the very top of our great industrial establishments to solve the fine points in producing enormous quantities of high grade castings, and to make them cheap. These men are to be found in our foundrymen's associations, in our great engineering societies, and wherever the active individuals of our industry get together to discuss questions of practice. I venture to say that without our progressive institutions of this kind, the foundry industry would be what it still is in some of our large cities, where the pig iron salesman makes the mixture, and the ignorance of the customer makes the price.

I commend these few observations on the tendencies noted in our industry to your attention, for I know that even if you may never require a change of method or work in your own establishments, yet you have sons and friends who will branch out with the growth of the nation, and to these young men, destined to become the foundrymen of the future, you owe the benefit of your experience, and co-operation.

Subject Index for Transactions of American Foundrymen's Association for 1905.

Subject Index—Continued.

Author's Index American Foundrymen's Association's Transactions for 1905.